

Inquiry: The University of Arkansas Undergraduate Research Journal

Volume 8

Article 1

Fall 2007

Inquiry: The University of Arkansas Undergraduate Research Journal - Volume 8 - Fall 2007

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Editors, Inquiry (2007) "Inquiry: The University of Arkansas Undergraduate Research Journal - Volume 8 - Fall 2007," *Inquiry: The University of Arkansas Undergraduate Research Journal*: Vol. 8 , Article 1.

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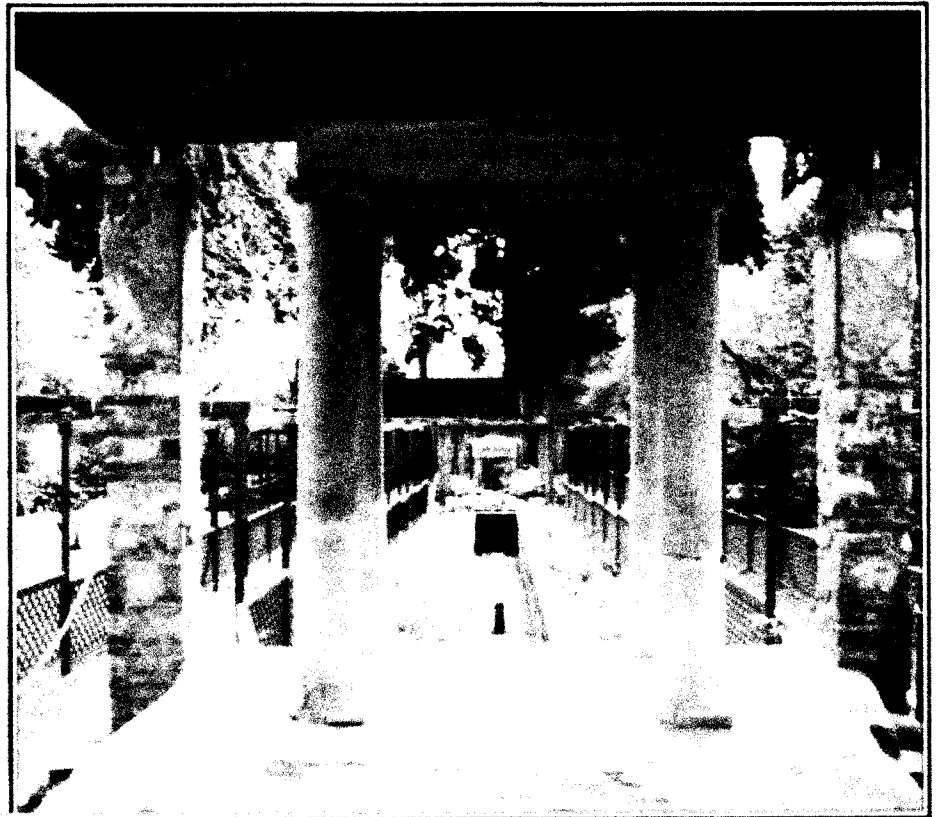
Editors: Inquiry: The University of Arkansas Undergraduate Research Journal

THE UNIVERSITY OF ARKANSAS
UNDERGRADUATE RESEARCH JOURNAL

INQUIRY

Volume 10

Fall 2007

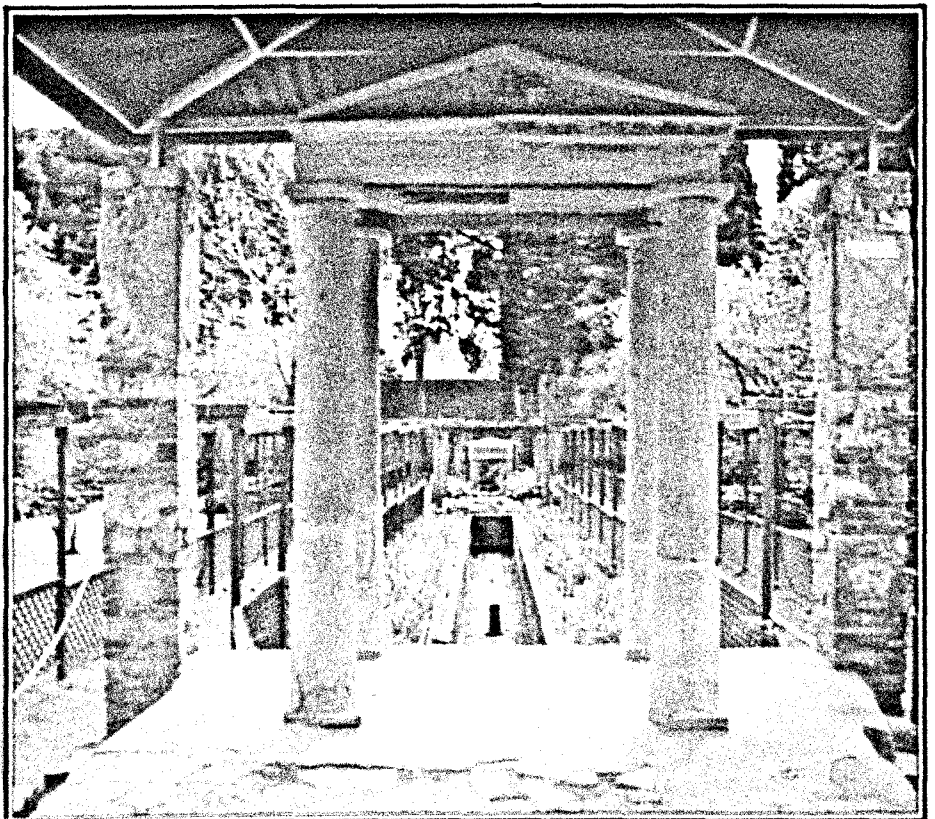


THE UNIVERSITY OF ARKANSAS
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INQUIRY

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INQUIRY: The Undergraduate Research Journal of the University of Arkansas

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Foreword

This issue of *Inquiry*, the eighth in an annual series, is a project of the Teaching Academy of the University of Arkansas and is testimony to the Academy's belief that a function of good teaching is to encourage good research and creative thinking on the part of students. The journal is supported financially and philosophically by the offices of the Provost Bob Smith and the Vice Chancellor for Research Collis Geren.

Volume 8 of *Inquiry* records the individual scholarly efforts of eight U of A student/faculty mentor pairs during the 2006/2007 academic year. The projects included here are drawn from faculty and student disciplines in five undergraduate colleges and schools—the Dale Bumpers College of Agricultural, Food, & Life Sciences; the J. William Fulbright College of Arts and Sciences, the Sam M. Walton College of Business, the College of Education and Health Professions, and the College of Engineering. The articles are representative of the quality of research done by students in the various disciplines represented on campus. While many submissions are the work of honors students, *Inquiry* encourages submissions from any undergraduate student whose scholarly and creative work merits publication. The breadth of subject matter included here is testimony to the commitment made throughout the university to research at the undergraduate as well as the graduate level. Where else could one have the opportunity to read, in one journal, about tomatoes and nematode infestations, symbolic power landscapes associated with anxiety induced in Roman homes, the language development of twins, a cough monitoring system, factors influencing the German economy, anti-immigration issues in developing countries like Costa Rica, race and identity in the Dominican Republic, and the efficacy of campaigns designed to reduce smoking and counteract previous tobacco industry marketing.

These articles were chosen by a process of review involving members of *Inquiry*'s Publication Board and faculty members with expertise appropriate to assessing the quality of the work. The range of disciplines at an institution like ours makes it impossible for the Board itself to be able to evaluate all the papers submitted. We are grateful for the assistance that we receive from faculty colleagues. As has been true in the past, the number of articles accepted for publication is controlled in part by the size of the journal, and many additional publishable manuscripts were submitted.

The papers chosen vary in subject, writing style, and the manner in which they reference their research sources. As much as possible, we endeavored to maintain discipline-specific styles to provide students with a publication experience comparable to one they might find in their individual disciplines. In most instances, the paper published here is a digest of a larger research product. Part of the challenge of submission to *Inquiry* is turning somewhat lengthy theses into much shorter articles.

A personal note: Last year, Professor Emeritus Murray Smart, Jr. wrote here to inform readers that he was turning over the leadership to a new Editor. In many ways, this journal has been Professor Smart's creation, and his dedicated efforts over the years made *Inquiry* the quality publication that it is today. As the new Editor, I can tell readers that I am astounded at the time, effort, and vision Professor Smart contributed to the journal. I also appreciate all the assistance he gave me when I began my editorial duties. For this issue, I made the simple choice of following in Professor Smart's footsteps as much as possible. I have learned a great deal during this first year and look forward to working collaboratively in the coming years with students, faculty and administrators who share the Teaching Academy's commitment to showcasing undergraduate research. For now, though, many thanks are due to Professor Smart.

Barbara B. Shadden, Editor

THE EFFECTS OF NEMATODE INFECTION AND MI-MEDIATED RESISTANCE IN TOMATO (*SOLANUM LYCOPERSICUM*) ON PLANT FITNESS

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Faculty Mentor: Fiona L. Goggin

Department of Entomology

Abstract

*The Mi gene in tomato (*Solanum lycopersicum*) is a single, dominant resistance (R) gene that confers resistance against several species of insects and root-knot nematodes. This study examined the impact of root-knot nematode infestation and the plant growth and reproduction of near-isogenic tomato cultivars with and without Mi. The objectives of this experiment were to examine the potential fitness costs and benefits of the R gene-mediated herbivore resistance, and to explore the role of nematodes as a selection pressure favoring plants that carry Mi. Mi-mediated resistance dramatically reduced nematode reproduction on tomato. In the presence of nematodes, plants that carried Mi produced larger fruits and greater foliar biomass than susceptible plants. Both resistant and susceptible plants, however, were able to compensate for heavy nematode infestation, and neither genotype showed a significant reduction in yield or estimated lifetime seed production in response to infestation. Therefore, Mi-mediated resistance did not provide a fitness benefit to the plants under the infestation level tested. Seeds from plants that carried Mi also had lower germination rates than seeds from susceptible plants, suggesting that there may be a metabolic fitness cost associated with Mi-mediated nematode resistance.*

Introduction

Plants display an array of sophisticated biochemical and morphological traits that limit attack from a variety of pests, such as pathogens, insects, and other herbivores. "Acquired" or "induced" resistance is dependent upon a conglomeration of traits that are upregulated by pest damage, and that can reduce the severity of subsequent assaults from a broad range of potential attackers (Agrawal, 2005; Cipollini et al., 2003). This phenotypic plasticity is presumed to be controlled by many interacting genes in the plant. In contrast, R gene-mediated pest resistance rapidly blocks initial attacks by one or a small number of pest species, and is controlled by simple but highly specific gene-for-gene interactions between the plant and the pest (Dangl and Jones, 2001; Kaloshian, 2004). According to this model, the presence of a single resistance (R) gene in the plant allows the rapid detection of a corresponding avirulence (Avr) gene in the pest, resulting in incompatibility (Flor, 1971).

Regardless of whether it is acquired or R-gene mediated, any plant trait that blocks pest establishment

or limits their proliferation can be considered a source of resistance. However, Karban and Baldwin (1997) propose that the term "plant defense" should be reserved for traits that have also been shown to enhance plant fitness in the presence of pests. Fitness represents the plant's lifetime reproductive success and is the critical trait on which natural selection acts. The term "plant defense" implies that the trait in question is an adaptation to pest pressure.

Plant-herbivore interactions have long been used as model systems to study co-evolution (Agrawal, 1998; Baldwin, 1998; De Meaux and Mitchell-Olds, 2003). The theory of co-evolution proposes that reciprocal genetic changes have occurred in plants and their associated herbivores, driven by the costs and benefits of these changes to Darwinian fitness. According to this hypothesis, plants have developed a variety of resistance traits (e.g., thorns, trichomes, toxic chemicals, and antinutritive proteins) to combat herbivory and limit its fitness costs (Agrawal and Tuzun and Bent, 1999; Sagers and Phyllis, 1995). Through selection, insects have responded with adaptations to cope with the new plant traits, such as detoxifying enzymes or behavioral avoidance mechanisms (Gardner and Agrawal, 2002; Strauss and Agrawal, 1999). Many of the plant traits that deter herbivores, however, could potentially have developed in response to other selective pressures. For example, leaf trichomes have been identified in biological functions such as toxin removal, UV protection, and water retention (Smith and Hare, 2004). These abiotic factors may aid in the selection of trichome production or trichome density (Gianoli and Gonzallez-Teuber, 2005; Karkkainen et al., 2004). Therefore, before making any inferences about the adaptive significance or evolutionary history of a particular form of resistance, empirical tests are needed to assess the costs and benefits of this trait to plant fitness in the presence and absence of pests.

The majority of studies that have examined the costs and benefits of resistance have focused on traits that contribute to induced insect resistance, such as trichome density in wild radish (*Raphanus* spp.) and nicotine synthesis in a wild tobacco (*Nicotiana attenuata*) (Agrawal, 1999; Karban et al., 1997). Fewer research groups have assessed the effects of R genes on plant reproductive success, although dramatic progress has recently been made in studying R gene mediated bacterial resistance in *Arabidopsis thaliana* (Korves and Bergelson, 2004; Tian et al., 2003). Data from this system suggests that wild *Arabidopsis* populations experience

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intermittent periods of extreme pathogen attack, during which plants that carry *RPM1* and other R genes for disease resistance have a strong selective advantage. During periods of low pathogen incidence, however, susceptible plants boast higher fitness than resistant genotypes. Bergelson and coworkers propose that as a result of these trade-offs, both resistant and susceptible alleles of R gene loci are maintained in *Arabidopsis* populations through balancing selection (Korves and Bergelson, 2004; Tian et al., 2003).

The goal of the present study was to use tomato as a model system to measure the fitness costs and benefits of R gene mediated herbivore resistance. The *Mi* gene is present in many tomato cultivars and confers resistance to three common root-knot nematode species (*Meloidogyne incognita*, *M. javanica*, *M. arenaria*), as well as three insect species (potato aphid, *Macrosiphum euphorbiae*; sweetpotato whitefly, *Bemisia tabaci*; tomato psyllid, *Bactericera cockerelli*) (Casteel et al., 2006). This gene was introduced into cultivated tomato, *Solanum lycopersicum*, by crossing it with a wild relative, *S. peruvianum* (Smith, 1944). Our study focused on the effects of *Mi* on root-knot nematode, which are the most damaging of these herbivores on tomato. Root-knot nematodes disrupt the vascular system of their host plant causing symptoms that include stunted plant growth, chlorosis or premature death, and that increase susceptibility to drought and other pathogens (Jenkins and Taylor, 1967; Olsen, 2000). These endoparasites cause severe yield reductions in agricultural crops including cultivated tomato, and *Mi* is the only known source of root-knot nematode resistance in cultivated tomato (Williamson, 1998). In plants that carry *Mi*, a hypersensitive reaction (HR), which involves rapid localized cell death, stops the nematode from establishing a feeding site (Williamson, 1998). *Mi*-mediated resistance dramatically reduces root-knot nematode numbers and has been shown to increase tomato yield in both greenhouse and field experiments (Sorribas et al., 2005; Lopez-Perez et al., 2006). However, the impact of *Mi* on seed production has not been examined. To this end we conducted a full factorial experiment to assess the effects of nematode infection and *Mi*-mediated resistance on plant growth and reproduction. The goals of this study were to examine the potential fitness costs and benefits of *Mi*, and to explore the potential role of nematodes as a selection pressure favoring *Mi*-mediated resistance.

Methods and Materials

Plant Materials. Two near-isogenic tomato cultivars Castlerock II (*Mi*⁻, susceptible) and Sun 6082 (*Mi*⁺, resistant) were used for this assay. All plants were grown in 11-liter plastic pots of autoclaved sand (Play Sand, Quikrete, Atlanta, GA) under stable greenhouse conditions (~24°C-27°C; 16:8 L:D photoperiod). Tomatoes were watered three times daily with a nutrient solution containing 1000 mg/L CaNO (Hydro Agri North America, Tampa, FL), 500 mg/L MgSO (Giles

Chemical Corp, Waynesville, NC), and 500 mg/L Hydroponic 4-18-38 Growmore fertilizer (Growmore, Gardena, CA).

Nematode cultures and inoculation. Root-knot nematodes, *Meloidogyne javanica* (VW4 isolate), were obtained from Dr. V. M. Williamson (University of California, Davis). Nematodes were maintained on susceptible tomato plants (cv. MoneyMaker), under the same greenhouse conditions and fertilization regime described above. Nematode eggs were collected from colony plants inoculated at least seven weeks. Eggs were extracted from infected root systems using a 1% sodium hypochlorite solution, and were resuspended in water and quantified by examining serial dilutions with a light microscope (Hussey and Barker, 1973). Experimental plants were inoculated with 20,000 nematode eggs via pipette on each side of the root crown, while control plants were mock-inoculated with water.

Fitness Factors. Four tomato plant treatment conditions were used: susceptible inoculated, susceptible control, resistant inoculated, and resistant control. For each condition, 8 plants/treatment) were grown and allowed to fruit. The fruit was collected and weighed as it became ripe. Fruit was collected twice a week for ten weeks, and at ten weeks all remaining green fruit was collected. Three tomatoes of average size were chosen from each plant for seed extraction. Seeds were counted and weighted (AG285, Mettler Toledo, Columbus, OH) for analysis. Total foliar biomass (stems and leaves) was collected after four months of growth, and dried for five days at 26°C before being weighed. Whole root systems were collected and sent to a nematology diagnostics facility (Dr. Kirkpatrick, University of Arkansas, Hope) for nematode egg quantification. Whole root systems were dried and weighed after nematode extraction.

Germination. Germination rates were measured from a sub-sample of the seeds collected (10 seeds/plant; eight plants/treatment group). Seeds were sown in 1 cup plastic square pots of vermiculite (Vermiculite, Schultz, Atlanta, GA) and grown in greenhouse conditions same as above, and watered daily with tap water. Germination rate was recorded every two days for ten days after planting.

Statistics. Tomato yield, seed count and weight, root and foliar dry weight, and nematode reproduction were compared on our four treatment groups using full factorial 2-way analysis of variance (ANOVA) and student's t-test (JMP version 5.01, SAS Institute, Cary, NC).

Results

Nematode Infection. Nematode data was transformed for analysis using the formula 'log +1'. *Mi*-mediated resistance significantly reduced nematode reproduction, as measured by the number of egg masses per gram of root mass (Figure 1) ($F=0.835$; $df=1, 28$; $P=0.0004$).

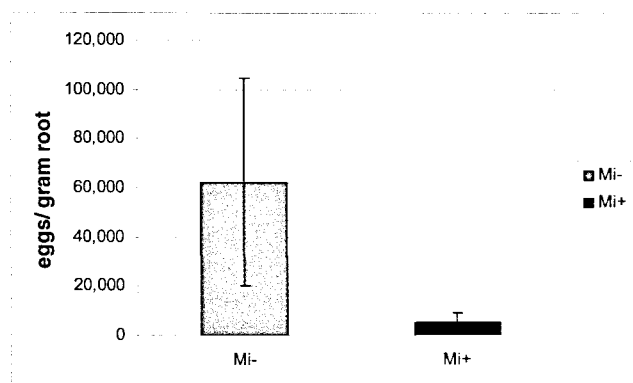


Figure 1. Effects of *Mi*-mediated resistance on nematode reproduction.

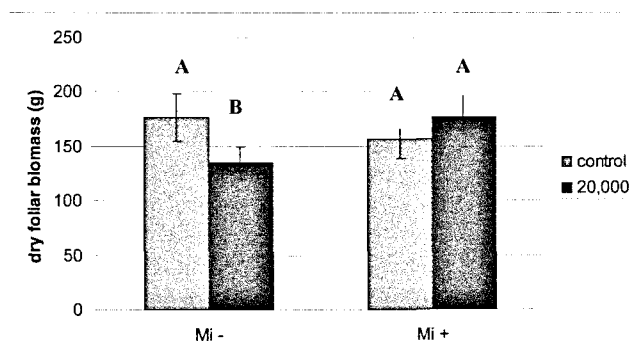


Figure 2. Effects of *Mi*-mediated resistance and nematode inoculation on dry foliar weight of tomato plants.

Plant Growth. When foliar dry masses were analyzed, there was a significant interaction between plant genotype and nematode inoculation (Figure 2) ($F=16.7227$; $df=1, 28$; $P=0.0003$). Nematode inoculation significantly reduced foliar dry weight of the susceptible (*Mi*-) genotype ($t=3.976$; $df=28$; $P=0.0004$), but did not reduce the dry weight of the resistant (*Mi*+) cultivar ($t=-1.807$; $df=28$; $P=0.0814$). Nematode

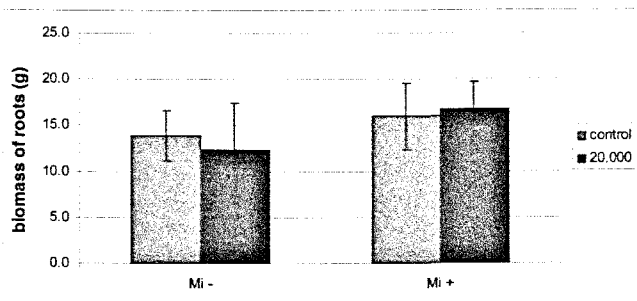


Figure 3. Effects of *Mi*-mediated resistance and nematode inoculation on root weight of tomato plants.

inoculation did not significantly affect whole root weight (Figure 3) ($F=0.0274$; $df=1,28$; $P=0.8697$), nor was there a significant interaction between inoculation and plant genotype ($F=0.202$; $df=1,28$; $P=0.6566$). Root weight was significantly higher for the resistant genotype than for susceptible genotype ($F=5.936$; $df=1,28$; $P=0.0214$).

Fruit Production. Neither nematode inoculation nor plant genotype had a significant effect on the number or total weight of mature fruits collected (Table 1). When the average weight per mature fruit was analyzed, there was a significant interaction between genotype and nematode inoculation. In the presence of nematodes, resistant plants produced significantly larger fruits than susceptible plants ($t=2.48$; $df=28$; $F=0.019$). There was no significant difference among treatments in the number, total weight, or average weight of green fruits collected from the plants at the termination of the experiment, when fruit production was waning (Table 2).

Genotype	Inoculation	Mature Fruit/ Plant (mean \pm S.D.)	Avg Mature Fruit Wt. (g) (mean \pm S.D.) ^a	Yield of Total Mature Fruit (g) (mean \pm S.D.)
<i>Mi</i> -	control	14.9 \pm 7.1	37.8 \pm 4.3ab	560.6 \pm 272.0
	inoculated	14.5 \pm 6.7	33.3 \pm 7.7b	489.6 \pm 287.1
<i>Mi</i> +	control	11 \pm 5.7	35.6 \pm 11.5ab	415.8 \pm 280.2
	inoculated	13.9 \pm 7.5	43.9 \pm 8.9a	582.4 \pm 309.0

ANOVA results	Genotype effect	$F_{1,28}=0.8847$ $P=0.3550$	$F_{1,28}=1.9572$ $P=0.1728$	$F_{1,28}=0.0655$ $P=0.7999$
	Inoculation effect	$F_{1,28}=0.2731$ $P=0.6054$	$F_{1,28}=0.4107$ $P=0.5268$	$F_{1,28}=0.2211$ $P=0.6418$
	Interaction	$F_{1,28}=0.4615$ $P=0.5025$	$F_{1,28}=4.4575$ $P=0.0438$	$F_{1,28}=1.3678$ $P=0.2520$

Table 1. Mature fruit production.

Genotype	Inoculation	Avg. Green Fruit/ Plant (mean \pm S.D.)	Avg. Green Fruit Wt. (g) (mean \pm SEM)	Yield of Total Green Fruit (g) (mean \pm S.D.)
<i>Mi</i> -	control	1 \pm 0.9	20.5 \pm 8	286.3 \pm 46.2
	inoculated	2.3 \pm 2.4	16.5 \pm 5.2	433.9 \pm 55.3
<i>Mi</i> +	control	1.5 \pm 2.4	15.1 \pm 5.8	345.3 \pm 66.1
	inoculated	1.5 \pm 1.0	23.3 \pm 5.2	363.3 \pm 38.7

ANOVA results	Genotype effect	$F_{1,28}=0.0366$ $P=0.8496$	$F_{1,28}=0.0117$ $P=0.9147$	$F_{1,28}=0.0015$ $P=0.9692$
	Inoculation effect	$F_{1,28}=0.9162$ $P=0.3467$	$F_{1,28}=0.1062$ $P=0.7470$	$F_{1,28}=0.3097$ $P=0.5823$
	Interaction	$F_{1,28}=0.9162$ $P=0.3467$	$F_{1,28}=0.8739$ $P=0.3579$	$F_{1,28}=0.1897$ $P=0.6665$

Table 2. Green fruit production.

Seed production. Nematode infection significantly reduced the average number of seeds per fruit and per gram of fruit weight, as well as the amount of seed produced relative to the total plant biomass (Table 3). Plant genotype (*Mi*- and *Mi*+) did not significantly influence any of these parameters. The season-wide seed production per plant was estimated by multiplying the total number of grams of ripe

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fruit produced by the average number of seeds per gram for the tomatoes sampled. This estimated seed production did not differ significantly among treatments. Seed weights and germination rates were also evaluated as a measure of seed quality and viability. The average size of individual seeds did not differ among treatments (genotype: $F=1.234$; $df=1,28$; $P=0.276$, treatment: $F=0.3381$; $df=1,28$; $P=0.5656$, interaction: $F=2.5532$; $df=1,28$; $P=0.1213$). Germination rates on days 5, 7, and 10 after planting were all significantly lower for the resistant cultivar than for the susceptible plants ($P \leq 0.01$ for all time points), whereas nematode infection did not influence germination rates or interact significantly with genotype ($P > 0.05$ for all time points) (Figure 4).

Genotype	Inoculation	Average seeds/ fruit (mean \pm SEM) #	Average seeds/ (g) fruit (mean \pm S.D.)	Average seeds/ (g) dry foliar and root weight (mean \pm S.D.)	Estimated lifetime seed production (mean \pm S.D.)
Mi-	control	39.6 \pm 9a	0.25 \pm 0.19	0.62 \pm 0.4	363.5 \pm 227.9
	inoculated	21.6 \pm 6.8b	0.14 \pm 0.1	0.43 \pm 0.41	256.9 \pm 260.7
Mi+	control	56.1 \pm 7.9a	1.03 \pm 1.57	0.99 \pm 0.41	333.3 \pm 214.5
	inoculated	26.5 \pm 6.4b	0.16 \pm 0.1	0.41 \pm 0.26	315.6 \pm 422.4

ANOVA results	Genotype effect	$F_{1,28}=1.9659$ $P=0.1719$	$F_{1,28}=2.0929$ $P=0.1591$	$F_{1,28}=0.5971$ $P=0.4462$	$F_{1,28}=0.0188$ $P=0.8919$
	Inoculation effect	$F_{1,28}=9.7250$ $P=0.0042$	$F_{1,28}=3.0511$ $P=0.0916$	$F_{1,28}=0.8049$ $P=0.3773$	$F_{1,28}=0.3591$ $P=0.5538$
	Interaction	$F_{1,28}=0.5815$ $P=0.4521$	$F_{1,28}=1.8620$ $P=0.1833$	$F_{1,28}=0.3755$ $P=0.5450$	$F_{1,28}=0.1833$ $P=0.6719$

Table 3. Seed production.

Values followed by the same letter are not significantly different from each other, $P > 0.05$

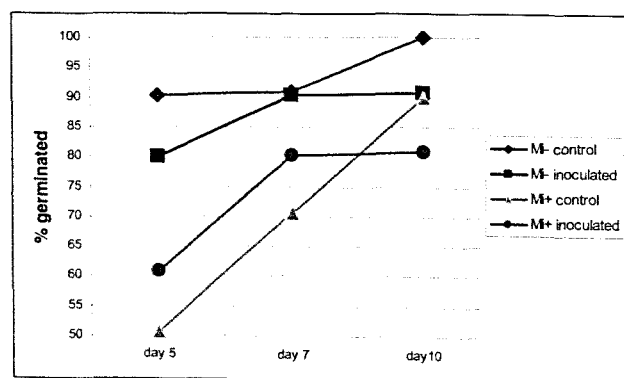


Figure 4. Effects of *Mi*-mediated resistance and nematode infestation on germination rate.

Discussion

In this experiment, we observed only a modest effect of nematodes on plant performance. Nematode infection reduced the foliar dry weight of susceptible plants, and the number of seeds per fruit collected from resistant as well as from susceptible plants. However, nematodes did not significantly influence the fruit yield or the estimated total seed production of either genotype. These results indicate that the tomato plants in this study were able to compensate for

high levels of nematode infestation without a negative effect on fitness. This is consistent with data presented in two recent studies of nematode infestation on tomato. Lopez-Perez et al. (2006) inoculated greenhouse-grown plants with 0, 10², 10³, 10⁴, and 10⁵ root-knot nematode eggs, and found that only the highest inoculum level significantly reduced the total fruit mass produced by a susceptible (*Mi*-) tomato cultivar. In a field study, Sorribas et al. (2005) grew a susceptible cultivar in naturally infested soil for three consecutive years and observed abundant galls and nematode eggs on the roots (~40,000 – 50,000 eggs/ gram root mass). Although this study concluded that total yield over three years was lower in infested versus fumigated soil, a year-by-year analysis of the data shows that nematodes significantly reduced yield in only one out of three field seasons.

The susceptible plants grown in this study appear to have used some form of tolerance to maintain normal reproductive levels when challenged with nematodes. In contrast to resistance, defined as any trait that reduces infestations, tolerance reduces the impact of infestations on plant fitness (Restif and Koella, 2004). The physiological and molecular mechanisms underlying tolerance are not thoroughly understood, but are thought to involve relocation of resources such as photoassimilates to less vulnerable parts of the plant (Agrawal, Strauss and Stout, 1999). Plants display varying degrees of tolerance against biotic and abiotic stresses, and selection for tolerance in crop plants has been a goal of agricultural breeding for decades (Wiley, New York, 1951). More recently, experiments to determine how plants use tolerance are increasing. A recent study by Schwachtje et al. showed *Nicotiana attenuata* relocates sugars to roots, immediately following simulated herbivore attack, for storage and future regrowth (Schwachtje et al., 2006).

While the plants in our study were able to compensate for nematode infection, this is not always the case; root-knot nematodes are a major agricultural pest that can cause dramatic yield losses on tomato (Olsen, 2000; Sorribas, 2005). The growing conditions used for this study may have helped limit the impact of nematode infection on plant fitness. Nematodes reduce root translocation and predispose their host plants to drought stress and disease (Olsen, 2000). The plants in this experiment were grown in greenhouse conditions with daily irrigation and fertilization, whereas plants grown in field conditions may have a more limited amount of water and nutrients to allocate for growth and reproduction. Furthermore, plants in this study were grown in autoclaved sand, absent of root pathogens and other pests that might otherwise attack plants stressed by nematode infestation. Therefore, plants grown in the “optimum” conditions of our greenhouse only had to defend themselves against one pest, allowing plentiful resources to be used for growth and reproduction.

Because nematode infection in this study did not significantly reduce the estimated total seed production by susceptible plants, we were not able to measure any

potential benefit of *Mi*-mediated resistance to plant fitness. *Mi* dramatically reduced nematode populations on tomato plants and conferred a modest benefit for fruit size and foliar biomass in the presence of nematodes; however, it had no major impact on yield or seed production. Notably, seeds from resistant plants also had lower germination rates than seeds from susceptible plants. Resistance could be associated with a metabolic cost to the plant, as reported by Korves and Bergelson (2004) for R-gene mediated pathogen resistance. However, the two cultivars used in our study are not perfectly isogenic, and the observed difference in germination could be due to genetic differences unrelated to *Mi*. To test this, we would need to test the germination rates of cultivars that carry *Mi* in other genetic backgrounds.

In the future, it would be useful to test the effects of *Mi* on plant fitness in the presence of higher nematode densities that might have a greater impact on plant reproduction. It would also be worthwhile to test the effects of *Mi* on the fitness of plants challenged by multiple pests. As mentioned previously, nematodes can impact plants by predisposing them to attack by other pests. Furthermore, *Mi* also affects aphids, whiteflies, and psyllids, all of which could have an additive effect on plant fitness, and could be important selection pressures on tomato. Future studies could also examine the effects of *Mi* on reproduction rates in *S. peruvianum*, the wild tomato species from which this gene was introduced into cultivated tomato. It is interesting to note that nematodes in this study had a larger effect on seed production than on fruiting; they reduced the number of seeds per fruit (Table 3), but did not affect the number or total weight of fruit produced (Table 1). This could be due to the fact that we worked with cultivated varieties that were artificially selected for fruit production. In addition, it may be useful for future experiments to consider ecological factors such as competition among plants, weather and water availability, light, flowering time, pollinators, and migration patterns of other herbivores (Hiel, 2002). The diversity of a plants' environment plays a role in fitness through an unlimited number of factors that are difficult to simulate in a greenhouse experiment, due to methodological limitations (Agrawal, 2005; Hiel, 2002). Further work is necessary to investigate the costs and benefits of *Mi*-mediated resistance.

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Mentor Comments

Dr. Fiona Goggan describes the rigor of Mr. Corbett's research and the recognition of its quality at a regional meeting of the primary professional organization in their field.

The research project described in this manuscript was the basis for Brandon Corbett's undergraduate Honors thesis in Biology, which he successfully defended in April 2007. To initiate his thesis project in my laboratory, Brandon conducted a literature survey on the evolution of plant defenses against insects and pathogens. The evolution of plant resistance (R) gene families that confer disease resistance is a very active and exciting research area. Few if any

studies, however, have examined the maintenance and diversification of genes for herbivore resistance in an evolutionary context. Furthermore, most of the relevant studies of disease resistance infer the evolutionary history of R genes from DNA and amino acid sequence comparisons among homologous genes. In other words, the focus of these studies is at the molecular level, and few of these studies examine the biotic interactions and environmental factors that presumably drive the process of natural selection. In response to this gap in the literature, Brandon and I developed a project to quantify the costs and benefits of an herbivore resistance gene in the presence and absence of herbivory. The herbivore chosen for this study was the root-knot nematode, which has a world-wide distribution, can infect over 1,000 plant species, and is associated with severe yield losses on a wide variety of crops. Much to our surprise, Brandon's results indicated that susceptible as well as resistant tomato genotypes could sustain heavy nematode infestations without a significant loss in reproductive success. The findings of the greenhouse study reported in this manuscript were also corroborated by a field trial in which Brandon participated. These results may help explain why the Mi nematode resistance gene is not present in all populations of the Solanum species from which it was derived. This study also underlines the fact that any single resistance gene is only one part of a larger suite of different mechanisms by which plants adapt to herbivory. In particular, it highlights the importance of tolerance, which typically receives less study than resistance. Brandon continues to work on this project, and is currently examining the effects of different nematode inoculum levels on the costs and benefits of resistance. He has also begun to explore possible mechanisms of tolerance in tomato.

The academic rigor of Brandon's project and program of study are evidenced by his graduating with honors. Throughout this project, I have been very impressed by Brandon's hard work, perseverance, and dedication to research. Although the field of plant-herbivore interactions lies outside of Brandon's long-term interest in medicine, he enthusiastically approached his Honors project as an opportunity to gain hands-on experience in research, and to learn concepts of experimental design and analysis that can be applied to any area of biology. As a result, his project was a resounding success. Based on his research proposal, Brandon won a scholarship from the University of Arkansas Honors College to support the project. He also presented his results at the southeastern branch meeting of the Entomological Society of America, the primary professional organization in my discipline. Although undergraduates do not typically participate in this

type of conference, Brandon succeeded in winning first place in the Masters-level poster competition. As part of this competition, the judges talk with the competitors and assess their ability to explain their work and answer questions. I believe that Brandon's poise and knowledge of his topic as well as the quality of his

poster contributed to his winning this award. I am also very proud that Brandon is the recipient of the Inquiry student paper award. In short, it has been a pleasure to work with Brandon, and I'm sure that this project will be only one of many successes in his career.

THE POTENTIAL EFFECTS OF CORRECTIVE ADVERTISING ON CONSUMER BELIEFS MANDATED BY U.S. VS. PHILIP MORRIS USA, INC. (2006)

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Abstract

In US v. Philip Morris USA Inc. (2006), six major tobacco companies were ordered to provide funding for an extremely large corrective advertising and marketing campaign. The Court ruled that consumers may have been misled and deceived about the (1) health effects of smoking, (2) addictiveness of smoking, (3) lack of health benefit from low tar/light cigarettes, (4) companies' manipulation of nicotine delivery and cigarette design, and (5) health effects of secondhand smoke. Using print advertising copy test procedures, this research focused on the potential effectiveness of test ads submitted to the Court in impacting these target beliefs. In an initial pilot study, reliable multi-item measures for each of these belief themes were developed and assessed. These multi-item belief measures were then employed in the subsequent main study, in which the effects of two versions of a print advertisement (submitted to the Court in this litigation) were tested using a mixed experimental design. As hypothesized, results show that corrective ads can have a positive effect on the belief themes (compared to a control group not exposed to such ads), but there is an interaction demonstrating that some belief themes are more strongly affected by the test ads than are others. Results suggested that the beliefs about light / low tar cigarettes may be substantially affected by such a campaign. The addition to the ad copy of graphic visuals, such as those currently used on cigarette packages in Canada and Australia, had mixed results overall. Contributions of the research include the development of reliable multi-item measures for critical smoking-related beliefs, as well as implications of the copy test findings for this specific case and corrective advertising, tobacco counteradvertising, and public policy, in general.

Introduction

With an estimated 44.5 million people in the United States smoking cigarettes, it is apparent that the effects of smoking are widespread (Centers for Disease Control and Prevention 2005). A comprehensive report from the Centers of Disease Control and Prevention (2005) determined that cigarette smoking causes some 440,000 premature deaths annually. Although such statistics suggest that the harmful health risks and other adverse consequences of smoking should be well-recognized by most consumers, a United

States federal court has recently ordered the use of advertising and promotion to augment consumer knowledge by targeting potential misperceptions related to smoking. Specifically, in *US vs. Phillip Morris USA, Inc.*, Judge Gladys Kessler ordered tobacco companies to initiate corrective advertising related to consumer beliefs regarding cigarette smoking, given the premise that consumers may have been misled by tobacco companies' marketing efforts over the past fifty years. Antismoking media campaigns have been shown to be a critical aspect of tobacco control programs, and according to the Court's judgment (*US vs. Phillip Morris USA, Inc. 2006*, p. 4), tobacco companies will be required to:

[make] corrective statements concerning each of the following: (a) the adverse health effects of smoking; (b) the addictiveness of smoking and nicotine; (c) the lack of any significant health benefit from smoking "low tar," "light," "ultra light," "mild," and "natural," cigarettes; (d) defendants' manipulation of cigarette design and composition to ensure optimum nicotine delivery; and (e) the adverse health effects of exposure to secondhand smoke (also known as environmental tobacco smoke, or ETS).

The advertising and promotion actions that are being required include prime-time television, newspapers, package "onsets" and retail displays as part of the integrated marketing communications campaign. This campaign will focus on communicating specific messages related to prior misleading statements and marketing by major tobacco companies. Thus, the goal of this overall corrective campaign is to mitigate any inappropriate or inaccurate consumer beliefs about smoking and to thwart any future deceptive marketing practices that possibly would contribute to or encourage tobacco use. The literature on corrective advertising indicates that in efforts to rectify the deception of consumers, campaigns can be required of firms when the courts determine that consumers have been misled by prior marketing and advertising (Wilkie, McNeill and Mazis 1984; Armstrong, Gurol, and Russ 1979). In the judgment for *US vs. Phillip Morris USA, Inc.* Judge Kessler states:

(This case) is about an industry, and in particular these Defendants, that survives, and profits, from selling a highly addictive product which causes diseases

that lead to a staggering number of deaths per year, an immeasurable amount of human suffering and economic loss, and a profound burden on our national health care system. Defendants have known many of these facts for at least 50 years or more. Despite that knowledge, they have consistently, repeatedly, and with enormous skill and sophistication, denied these facts to the public, to the Government, and to the public health community. Moreover, in order to sustain the economic viability of their companies, Defendants have denied that they marketed and advertised their products to children under the age of eighteen and to young people between the ages of eighteen and twenty-one in order to ensure an adequate supply of "replacement smokers" as older ones fall by the wayside through death, illness, or cessation of smoking. (pp. 3-4).

This decision by Judge Kessler will require massive promotional expenditures (many millions of dollars) by major tobacco companies. These companies include Philip Morris, Altria, Brown & Williamson, Lorillard, R.J. Reynolds, and British-American Tobacco. Her ruling indicates the perceived importance of using integrated marketing communications in efforts both to remedy past deceptive business practices and to help impact future practices as well.

Therefore, this paper reports the results of: (1) a pilot test, to initially develop measures and assess consumers' beliefs about specific themes related to smoking that are identified by Judge Kessler as targets for the corrective campaign, and (2) a subsequent experimental copy test study to assess effects of an ad submitted to the Court for potential use in the corrective campaign. Based on the ruling in *US vs. Phillip Morris USA, Inc.*, the five consumer beliefs identified by the Court will be examined. In the initial pilot study, reliable multi-item measures of the consumer beliefs were developed. In the subsequent primary experimental study for the thesis, measures developed in the pilot study were used to address the following research questions:

- (1) What are the levels for each of these beliefs and does the strength of these beliefs suggest that consumers have been misled or deceived on all of these beliefs, due to prior actions of tobacco companies?
- (2) Given the strength and consumers' confidence in these specific beliefs, are there some beliefs that are potentially more likely to be impacted by a corrective campaign than others?
- (3) What is the effect of proposed test advertisements on each of the specific belief types and consumers' confidence in these beliefs? How are these ads related to future smoking intentions and smokers' intention to quit?
- (4) Are some ads that integrate graphic pictorial cues relevant to the belief types more effective than current suggested print ads that contain only verbal copy?

Corrective Advertising and Study Background

Origins of Corrective Advertising

Corrective advertising was proposed in the 1970s by the Federal Trade Commission (FTC). It was intended for use by firms that had misled consumers, which "would have to rectify its [past] deception in future advertisements" and with the intent to deter future use of deceptive advertisements all together. One of the first noted cases involving corrective advertising was in 1969 and was deemed the "SOUP" case. In this case, students from George Washington University brought litigation against Campbell's Soup because of ads shown with clear marbles being placed at the bottom of bowls to force the ingredients to the top of the bowl for photographic purposes. When the courts banned the firm from this practice, the students petitioned the court to intervene in the case. They argued "that a corrective message was needed to inform consumers of the deception; otherwise, they would never become aware they had been deceived." Although the intervention was denied, the FTC stated that "the concept of corrective advertising was of interest and could be considered in more serious case circumstances." Less than six months later, the FTC began using corrective advertising in formal complaints against firms for deceptive practices (Wilkie, McNeill, and Mazis 1984). Research since this time has shown that corrective advertisements often appear to be capable of making a difference in the minds of consumers and altering beliefs about the product and its attributes. However, as indicated in many past cases, it may not be sufficient to completely correct consumer misperceptions (Malleons, Stephens, and Jaques 2005; Armstrong, Guroi, and Russ 1979; Wilkie et al. 1984).

Belief Themes Related to Tobacco Use

The five consumer beliefs tested in this thesis were drawn directly from the corrective advertisement themes set forth by Judge Kessler in *US vs. Phillip Morris USA, Inc.* Each of these themes was a focus of the trial and was originally derived after a landmark revelation of documents that had been concealed by the tobacco companies themselves. In addition, the study examined the effects of one additional theme, the deceptiveness of the tobacco companies, a theme related to the entire *US vs. Phillip Morris USA, Inc.* case, and a theme examined in past research (Netemeyer, Andrews, and Burton 2005; Tangari et al. 2007).

In 1998 secret documents from seven cigarette manufactures and two affiliated organizations were revealed for the first time. These documents disclosed information from six million company documents, including memos, faxes, and letters. In these documents, information disclosed included statements indicating that the tobacco industry and these companies did in fact know for many years that: (1) nicotine was addictive; (2) they were manufacturing a harmful product; (3) they failed to warn the public through their denial of the

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danger; and (4) they purposely increased the nicotine and its potency in the cigarettes (WHO 2006). Consistent with these documents, in the Final Judgment and Remedial Order, Judge Kessler is requiring the tobacco companies to make corrective statements concerning these specific issues that the tobacco companies had denied for so many years. Addressing the belief theme of the lack of health benefit from smoking "low tar," "light," "ultra light," "mild," and "natural," cigarettes, Judge Kessler states on page 3 of the Final Judgment and Remedial Order that tobacco companies will no longer be able to use...

forbidden health descriptors [including] the words "low tar," "light," "ultra light," "mild," "natural," and any other words which reasonably could be expected to result in a consumer believing that smoking the cigarette brand using that descriptor may result in a lower risk of disease or be less hazardous to health than smoking other brands of cigarettes (US vs. Phillip Morris USA, Inc. 2006).

Additionally, consistent with our test of belief themes, a corrective statement from the tobacco companies concerning "the addictiveness of smoking and nicotine" was required by Judge Kessler. This requirement was based on not only the scientific evidence of the addictiveness of cigarettes, but also revelations in the recently disclosed documents in which the companies make statements including:

"Think of the cigarette pack as a storage container for a day's supply of nicotine...think of the cigarette as a dispenser for a dose unit of nicotine."

Philip Morris chemist, 1972

"Very few consumers are aware of the effects of nicotine, i.e., its addictive nature and that nicotine is a poison."

Brown & Williamson, 1978

"[T]he entire matter of addiction is the most potent weapon a prosecuting attorney can have in a lung cancer/cigarette case. We can't defend continued smoking as "free choice" if the person was "addicted."

Tobacco Institute executive, 1980 (WHO 2006)

Thus, the dangers and risks to health posed by cigarette smoking were very apparent even in the middle of the last century. Companies were keenly aware of the relationship between smoking and addiction.

Pilot Study

The pilot study was initially conducted to 1) develop reliable multi-item measures of the belief themes identified in *U.S. vs. Philip Morris*, 2) examine consumers' level of confidence in these belief themes, and 3) test differences in the levels of the belief themes held by consumers. Pools of potential items were generated for each of the five belief themes plus beliefs about the deceptiveness of the tobacco

companies, a theme clearly related to the actions of the companies documented in *U.S. vs. Philip Morris*. Items were generated through a review of the literature (e.g., Netemeyer, Andrews and Burton 2005; Tangari et al. 2007) and development by the researchers. All items were seven point scales anchored by endpoints of "Strongly Disagree" ('1') and "Strongly Agree" ('7'). The participant sample was composed of 55 students enrolled in an upper division undergraduate business class. Ages ranged from 17 to 35 (Mean = 22.0); 50% were female and 50% male.

Both factor analyses and coefficient alpha reliability tests were used to reduce the number of belief theme items and develop reliable multi-item measures. Final measures and coefficient alpha reliabilities are shown in Appendix A. Reliabilities are all satisfactory (Nunnally and Bernstein 1994) for these belief theme scales. To measure confidence and consumers' certainty in these beliefs, a single item was used for each belief theme. For example, for the confidence in the belief regarding secondhand smoke, respondents were asked, "In general, how confident / certain are you that the ratings you gave on the above statements with regard to the harmfulness of secondhand smoke are correct?" These items were also measured on a seven-point scale using endpoints of "Not at all confident/certain" (coded as a '1') and "Extremely confident/certain" (coded as a '7').

These multi-item measures were then used to examine the mean scores and confidence levels for each of the belief themes. Means and tests of differences in means were examined using a series of t-tests are shown in Table 1.

Results in Table 1 suggest several conclusions relevant to *U.S. vs. Philip Morris USA*. First, the mean belief about the theme that level of low-tar/light was significantly lower than the other themes measured. Second, the mean confidence level of low-tar/light was also significantly lower than the other themes measured. Therefore, these findings suggest that the low-tar/light belief has the most probable chance of being changed through corrective advertising. This likelihood is reinforced by the fact that all of the belief means other than low tar/light were substantially above the scale midpoint of '4' ($p < .05$) based on t-tests for the seven point measure. The results also show that several means (e.g., secondhand smoke, health effects) were so close to the theoretical scale maximum (i.e., '7') that there is little room for upward movement due to the strength of the belief. For this small sample of undergraduate students, these findings suggest that corrective ads may be more likely to affect some of the beliefs identified in *U.S. vs. Philip Morris* than others.

Predictions for the Main Study Experiment

Effects on the Belief Themes

Tangari et al. (2007) recently examined effects of an anti-tobacco ad campaign run for many months in the state of Wisconsin. They focused on beliefs regarding tobacco

Table 1. Pilot Study Findings: Belief and Confidence Level Means

<u>Belief Theme</u>	<u>Mean Belief Theme Level</u>	<u>Mean Confidence Level</u>
Health Effects (a)	6.17 ^{d,e,f}	5.57 ^{b,e,f}
Addictiveness (b)	5.98 ^{e,f}	5.23 ^{a,c,d,f}
Secondhand Smoke (c)	6.26 ^{e,f}	5.68 ^{b,e,f}
Deceptiveness (d)	5.65 ^{a,c,f}	5.67 ^{b,e,f}
Cigarette manipulation (e)	5.63 ^{a,b,c,f}	5.18 ^{a,c,d,f}
Low-tar/Light (f)	4.59 ^{a,b,c,d,e}	4.59 ^{a,b,c,d,e}

Note: Superscript letters indicate significant differences in belief themes. For example, the health effects' mean is significantly different ($p < .05$) from the means for the belief themes of deceptiveness, cigarette manipulation, and low tar/light perceptions.

industry deceptiveness, smoking addictiveness, harmfulness of second-hand smoke, and restrictions on smoking at different public venues. Generally, they found that attitudes related to the campaign affected belief levels and had somewhat stronger effects on some beliefs (specifically, industry deceptiveness and secondhand smoke effects) than on others (addictiveness). Given their findings related to effects of an ad campaign across various beliefs in general, in H1 it is predicted that there will be positive effects on beliefs (in general) for consumers exposed to corrective test ads, as compared to consumer groups not exposed to the test ads. In addition, given pilot test results about differential belief strength, an interaction is predicted in H2--specifically, that exposure to the test ads will have a more positive effect on some belief themes (such as the light/ low tar theme) than themes such as health or addictiveness of smoking. Both the pilot study and past research on light / low tar cigarettes (Etter et al. 2003; Kozlowski and Pillitteri 2001, Kozlowski et al. 1998) indicate that many consumers may perceive health benefits from smoking light cigarettes, suggesting the potential for corrective advertising to affect this belief. These two primary research hypotheses are summarized below.

H1: Exposure to corrective ads will have a positive effect on belief themes compared to a control group not exposed to the corrective ads.

H2: Exposure to corrective ads will have a stronger effect on some belief themes than others. Specifically, the ads should have a more positive effect on the lack of health benefits of light and low tar cigarettes theme than the other belief themes.

The next prediction concerns the effect of the inclusion of visuals related to the belief themes in the corrective ads, compared to corrective ads that present only text copy.

Research concerning the use of graphic visuals on cigarette packages to help communicate information on the health effects of smoking indicates visual warnings on package fronts elicit higher levels of negative affect and reduced evaluations of the attractiveness of the package (Kees et al., 2006). In the same study, it was reported that using pictures increased both intent to quit smoking and perceived effectiveness in doing so. A reduction in smoking levels in Canada is attributed to the use of the visuals on Canadian cigarette packages (Hammond 2004). Thus, H3 predicts that:

H3: The use of visuals in corrective ads will increase the overall strength of effects on the belief themes compared to corrective ads not using visuals.

Predictions for Consumers' Confidence in the Belief Themes

In addition to interest in belief levels, the consumer belief and attitude literature has been concerned with belief certainty or confidence (Marks and Kamins 1988; Fazio and Zanna 1978). The confidence with which a belief is held potentially influences the effects of persuasion and behavioral consequences of the belief (Petty 2002). For many consumers, while the belief theme itself may not be influenced by a corrective advertisement, the confidence with which the belief is held may be influenced. Thus, based on the literature on confidence and results of the pilot study, the following is predicted for effects on consumer confidence.

H4: Exposure to corrective ads will have a positive effect on consumers' confidence in the belief themes compared to a control group not exposed to the corrective ads.

H5: Exposure to corrective ads will have a stronger effect on consumers' confidence in some belief themes

than on others. Specifically, the ads should have a more positive effect on consumers' confidence in the lack of health benefits of light and low tar cigarettes theme than the other belief themes.

H6: The use of visuals in the corrective ads will increase the overall confidence in effects on the belief themes compared to corrective ads not using visuals.

Methods Used in the Main Study

Procedure and Experimental Design of the Main Study

Study predictions were tested in a 3 X 6 mixed experimental design in which there was one between subjects factor and one within subjects factor. The between subjects factor was the corrective ad condition with the following three levels: (1) a control in which no ad was shown; (2) a corrective ad containing copy only; and (3) a corrective ad that contained both copy (identical to condition 2) and two graphic visuals (relating to focal belief themes) at the bottom of the ad. Procedures used followed the recommendations for advertising copy testing in legal cases involving potential deception (Maronick 1995). The corrective ad using only copy was an ad obtained as part of court documents in *US vs. Philip Morris USA, Inc.* Examples of the ad stimuli are shown in Appendices B and C. The ad addressed each of the belief themes for which consumers may have been misled, based on the ruling in *US vs. Philip Morris USA, Inc.* Respondents were exposed to only one of the three ad conditions, and conditions were randomly assigned to study participants. The within subjects factor consisted of the six belief themes of interest; all belief themes were measured for each of the participants in the sample.

Survey, Sample and Administration Procedures

The survey was constructed based around the belief themes listed in the Final Judgment and Remedial Order in the *US vs. Philip Morris USA, Inc.* The survey questions assessed the subjects' different beliefs surrounding the five themes, and the strength of and consumers' confidence in those beliefs. In conditions in which participants saw the corrective ads, filler ads were placed both before and after the corrective advertisement with the purpose of simulating a "real-life" experience in which a person would actually see a number of ads in a setting rather than one single advertisement. Approval of the study was obtained from the Institutional Review Board at the University of Arkansas, and standard informed consent procedures were used.

For the primary administration sample and method, participants were undergraduate students at the University of Arkansas with ages ranging from 18-35. Participants were given the survey during class in their normal classroom setting. In each instance, students were asked to read each question carefully and not return to previous sections once completed. Students exposed to corrective ad conditions were instructed to read each advertisement in the ad packet

(the test ad and the two filler ads) carefully and examine all pictures thoroughly. All participants received credit (varied according to each professor) for participating in the survey. Five classrooms were used for this administration procedure. The sample size was 134 with 45 percent males and 55 percent females. The average age of the sample was 22 years.

Measures

Belief measures tested in this study that are directly associated with *US vs. Philip Morris USA, Inc.* include the following: (a) adverse health effects of smoking, (b) smoking addictiveness, (c) lack of health benefit from smoking "low tar," "light," "mild," and "natural," cigarettes, (d) defendants' manipulation of cigarette design and composition to ensure optimum nicotine delivery, (e) and secondhand smoke. As noted previously, the sixth theme related to tobacco company deceptiveness (based on actions of the companies documented in *U.S. vs. Philip Morris USA, Inc.*). Participants' beliefs in each of the themes were assessed using multi-item seven point, Likert-type scales with endpoints of "Strongly Disagree" (coded as a '1') and "Strongly Agree" (coded as a '7'), and the measures are shown in Appendix A. Negatively worded items were recoded prior to creating the summed measures. All belief theme measures were summed and divided by the number of items to create mean belief scores. All coefficient α reliability estimates for the multi-item belief measures exceeded .70, and thus are considered acceptable (Nunnally and Bernstein 1994).

For the measures of the confidence in the six belief themes, seven point, single item measures were employed. Each statement used endpoints of "Not at all confident/certain" (coded as a '1') and "Extremely confident/certain" (coded as a '7'). Examples of the statements used to measure confidence include the following: "In general, how confident/certain are you that the ratings you gave on the above statements with regard to potential effects of regularly smoking cigarettes on diseases such as cancer, heart disease, and emphysema are correct?;" "In general, how confident/certain are you that the ratings you gave on the above statements with regard to the addictiveness of smoking are correct?"

Several measures were designed to address smokers specifically. A seven-point scale anchored with "Strongly disagree/Strongly agree" was used to assess whether respondents who were smokers had the desire to quit smoking. The statement read: "In general, I would like to quit smoking." To measure participants' smoking related intentions, a seven-point anchored scale with "Definitely not/Definitely yes" was used. Statements included: "Do you think you will be smoking cigarettes regularly one year from now?" and "Do you think you will be smoking cigarettes regularly five years from now?"

Results

Tests of Effects of the Advertisements on Belief Themes

H1 and H2 predicted that exposure to corrective ads would have a positive effect on belief themes (compared to a control group not exposed to the ads), and that the corrective ads would have a stronger effect on some belief themes than others. To test these predictions, a 3 X 6 mixed analysis of variance was performed initially using the corrective ad

manipulation as a between subjects factor and the belief theme types as a within-subjects factor. Follow-up univariate tests and contrasts were then performed to test effects between different ad conditions for each belief theme and specifically test the effect of the inclusion of the graphic visual in the ad (H3).

Results of the 3 X 6 analysis of variance identify a significant difference between beliefs ($F=28.6$, $p<.01$), a significant difference due to ad condition ($F=6.2$, $p<.01$), and a significant interaction between beliefs and ad conditions ($F=2.9$, $p<.01$). These results indicate that there is a significant effect of exposure to the corrective ad, but that the strength of this effect varies across the different beliefs. This pattern of findings supports H1 and H2.

Figure 1 shows that the means for these beliefs are relatively strong across all conditions, and are particularly high for the ad exposure conditions. However, note that even in the no ad control, all beliefs means are substantially above the scale midpoint of '4' (t-values range from 3.46 to 21.0; $p<.01$ for all tests). Also, the means are especially high for the health-related belief (Mean=6.26; $t=21.0$) and secondhand smoke effects (Mean= 6.28; $t=16.6$), with both approaching the theoretical scale maximum of '7.' These results are consistent with the pilot study, and indicate that despite past misleading actions and marketing tactics from the tobacco companies, this sample of consumers does not appear to have

been misled or have largely inaccurate beliefs about these consequences. Also consistent with the pilot study, the lowest belief mean is for the light/low tar cigarettes (Mean= 4.73), a score relatively close to the scale midpoint.

Table 2 shows results of univariate analyses of variance and follow-up contrasts for each of the belief themes. H2 predicted that the effect on beliefs about the lack of health benefits of light and low tar cigarettes would be stronger in relation to the other beliefs. As can be seen in Figure 1 and Table 2, there is an effect of the ad exposure on this specific belief (see line 3). The result of the analysis of variance for the light and low tar belief is significant ($F=7.6$, $p<.01$), and show that the ad condition impacts beliefs about health effects of light and low tar cigarettes.

As also shown in Figure 1 and Table 2, the ad appears to have effects on several of the other beliefs. Specifically, the exposure to the corrective advertisement has significant effects on the addictiveness beliefs

Figure 1

Effects of the Proposed Corrective Advertisement on Belief Themes

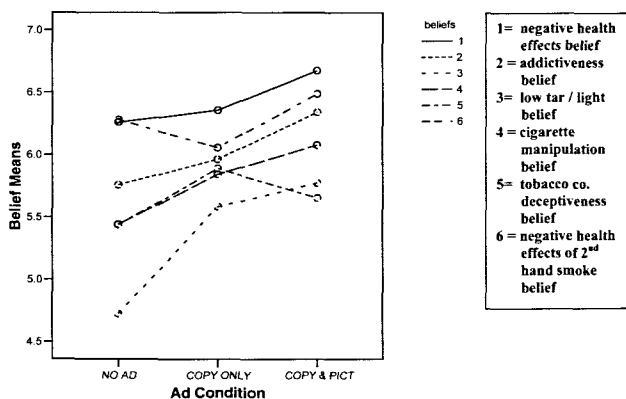


Table 2. Effect of the Corrective Advertisements on Smoking Belief Measures of Interest in US vs. Philip Morris, USA

Belief Themes	Mean Belief Values			F-Values
	No Ad (Control) ^a	Ad with Copy Only ^b	Ad with Copy and Graphic Visual ^c	
Health Effects	6.26 ^c	6.36 ^c	6.64 ^{a,b}	4.06 [*]
Addictiveness	5.76 ^c	5.96 ^c	6.32 ^{a,b}	4.98 ^{**}
Secondhand Smoke	6.28	6.06	6.46	2.08
Deceptiveness	5.44	5.89	5.60	1.32
Cigarette manipulation	5.44 ^{b,c}	5.84 ^a	6.07 ^a	4.39 [*]
Low-tar/Light	4.73 ^{b,c}	5.58 ^a	5.74 ^a	7.57 ^{**}

^{*} $p<.05$; ^{**} $p<.01$.

Note: Belief means are based on seven-point scales. For belief levels in which the ad condition had a significant effect, superscript letters indicate significant differences for follow-up contrasts between the ad conditions. For example, the belief in health effects' mean for the ad with both copy and the graphic visual is significantly different ($p<.05$) from the means for the no ad control and the ad with copy only, but the control and the ad with copy only are not significantly different.

($F=5.0$, $p<.01$), the manipulation beliefs ($F=4.4$, $p<.05$), and the health beliefs ($F=4.1$, $p<.05$). Exposure to the ad strengthens each of these beliefs. The effects of the ad condition on the secondhand smoke and the deceptiveness beliefs were nonsignificant ($p>.10$).

H3 concerns the effect of the graphic visual and predicts that the addition of the graphic visuals to the corrective ads will increase the overall strength of effects on the belief themes compared to corrective ads not using visuals. As shown in Table 2, contrasts (least significant differences) that examine the difference between the ads with the graphic visuals and the ads with copy only showed significant mean differences for the beliefs of health effects ($p<.05$), addictiveness ($p=.05$), and secondhand smoke ($p<.05$). As can be seen in Figure 1 and Table 2, each of the means for these beliefs in the context of the graphic visual is greater than the means when the ad uses copy only. Thus, these findings offer mixed results for tests of H3.

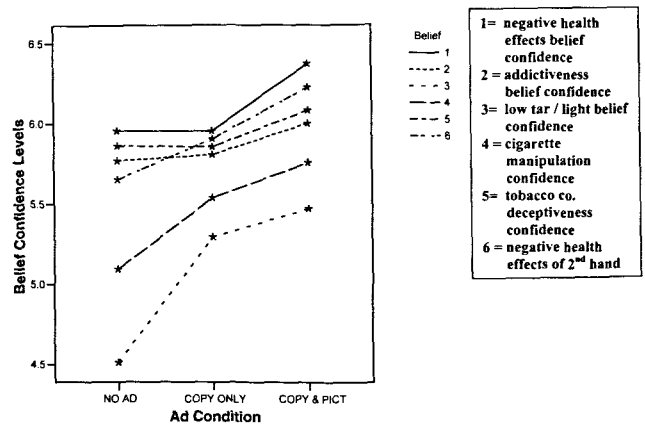
Tests of Effects of the Ads on Consumer Confidence in Their Beliefs about Smoking

Predictions H4 to H6 concern advertising effects on consumers' confidence in their beliefs. Similar to the analyses for the beliefs shown in the prior section, a 3 X 6 mixed analysis of variance was performed to test these predictions. Results of the 3 X 6 repeated measures analysis indicate that there is a significant difference in the confidence of beliefs ($F=27.8$, $p<.01$), a significant difference based on ad condition ($F=4.8$, $p=.01$), and a significant interaction between the beliefs and the ad condition

($F=2.0$, $p<.05$). Exposure to the corrective ad has a significant effect, but the strength of this effect varies across the different beliefs. This pattern of findings supports H4 and H5. Figure 2 shows a plot of the effects of the corrective ad exposure on belief confidence levels, and Table 3 shows univariate results and contrasts.

H5 predicts that exposure to corrective ads would have a stronger effect on consumers' confidence in some belief themes (i.e., lack of health benefits of light and low tar cigarettes) than on others. As can be seen in Figure 2 and Table 2, there is a substantial effect of the ad exposure on the light and low tar belief. The result of the analysis of variance for confidence levels of this belief is significant ($F=6.6$,

Figure 2
Effects of the Proposed Corrective Advertisement on Belief Theme Confidence



$p<.01$). In addition, as can be seen in Figure 2 and Table 3, the ad has effects on several of the other belief confidence levels. Specifically, the exposure to the corrective advertisement has significant effects on the confidence in manipulation beliefs ($F=3.6$, $p<.05$), the confidence in deceptiveness beliefs ($F=3.5$, $p<.05$), and the confidence of health related beliefs ($F=3.1$, $p=.05$). Effects of the ad condition on the confidence levels of secondhand smoke and addictiveness beliefs are nonsignificant ($p>.10$).

Table 3. Effect of the Corrective Advertisements on Consumers' Confidence in Smoking Beliefs of Interest in US vs. Philip Morris, USA

Belief Themes	Mean Confidence Values			F-Values
	No Ad (Control) ^a	Ad with Copy Only ^b	Ad with Copy and Graphic Visual ^c	
Health Effects	5.95 ^c	5.90 ^c	6.37 ^{ab}	3.05 [*]
Addictiveness	5.77	5.81	6.00	0.89
Secondhand Smoke	5.86 ^f	5.83	6.08	0.77
Deceptiveness	5.65 ^c	5.88	6.22 ^a	3.48 [*]
Cigarette manipulation	5.09 ^c	5.52 ^a	5.76 ^a	3.61 [*]
Low-tar/Light	4.51 ^{bc}	5.24 ^a	5.47 ^a	6.58 ^{**}

^a $p<.05$; ^{**} $p<.01$.

Note: Confidence measures are based on seven-point scales. For confidence levels in which the ad condition had a significant effect, superscript letters indicate significant differences for follow-up contrasts between the ad conditions. For example, the confidence in health effects' mean for the ad with both copy and the graphic visual is significantly different ($p<.05$) from the means for the no ad control and the ad with copy only, but the control and the ad with copy only are not significantly different.

H6 predicted that the addition of the graphic visuals to the corrective ads would increase the overall confidence in effects on the belief themes compared to corrective ads with no visuals. Contrasts that examine the difference between the ads with the graphic visuals and the ads with copy only showed significant differences for health effects ($p < .05$). As can be seen in Figure 2 the mean for the confidence level of this belief when the graphic visual is present is greater than the mean when the ad uses copy only. Thus, while Figure 2 shows that the inclusion of a graphic visual appears to increase confidence somewhat across all of the beliefs, Table 3 shows that it is statistically significant only for the confidence in health beliefs. Hence, these findings offer little support for tests of H6.

Do Effects of the Corrective Ads Differ for the Beliefs of Smokers vs. Nonsmokers?

While *US vs. Phillip Morris USA, Inc.* (2006) does not specify any differences between current smokers and nonsmokers, a key question for public policy and consumer welfare is whether the ads influence the beliefs of smokers. Thus, to address potential differences, a 3 X 2 X 6 mixed analysis of variance was performed in which smoking status was added as a third between subjects factor with beliefs again serving as the within-subjects measure. Consistent with prior literature (Netemeyer et al. 2005; Tangari et al. 2007), smokers were defined as those smoking cigarettes in the past thirty days and having smoked 100 cigarette or more in their life.

Findings show main effects of ad condition ($F=6.8$, $p < .01$), smoking status ($F=15.5$, $p < .01$), belief theme ($F=23.9$, $p < .01$) and significant interactions between the beliefs and ad condition ($F=2.7$, $p < .01$), and beliefs and smoking status ($F=2.6$, $p < .05$). As can be seen in Figure 3, the interaction plot

between beliefs and ad condition is very similar to the plot in Figure 1.

All belief means for smokers are at least slightly less than the corresponding belief means for nonsmokers. However, it is also apparent that there is a much greater difference in the belief concerning the deceptiveness of tobacco companies. For this belief, smokers' mean level is substantially below that of the nonsmokers ($F=15.9$; $p < .01$).

Effects of the Ads on Perceived Intentions to Quit Smoking

While no specific predictions are offered on advertising effects on intentions, from a public policy and health perspective, it is obvious that effects on smoking intentions and behavior are of interest. Given this fact, results for additional intentions and "desire to quit" variables for smokers only were explored. An analysis of variance was performed with dependent variables of intent to smoke one year from now, intent to smoke five years from now, and the desire to quit smoking. Results showed that ad exposure has no significant effect on the dependent variables. However, our sample size of smokers is very small ($n=36$) in this analysis.

Conclusions and Recommendations

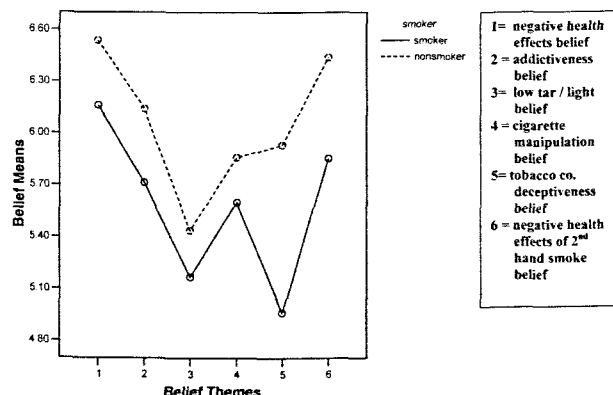
The primary motivation for this research is the recent Final Judgment and Remedial Order of Judge Kessler which, if upheld, will require that major tobacco companies implement a multi-million dollar corrective advertising campaign (*US vs. Philip Morris USA Inc.* 2006). Due to the past deceptive practices and marketing of the tobacco companies, this integrated marketing campaign would be used in attempts to change specific beliefs for which consumers may have been deceived in the past. Multi-item measures for each of the belief themes identified in *US vs. Philip Morris USA* were developed and initially assessed in a pilot study, and the development of these reliable scales is one primary contribution of this research. These measures were then employed in the subsequent main study, in which the effects of two versions of a print advertisement (which was submitted to the Court for use as a possible corrective ad in this litigation) were tested using a mixed experimental design. Thus, in accord with this Court judgment, advertising copy test principles were used to gauge how a corrective ad, such as the one recommended to the court, would affect the focal consumer beliefs identified in the litigation and confidence in these beliefs.

As predicted in H1 and H2, there was a significant effect of exposure to the corrective ad (compared to a control group not exposed to the ads), but that the strength of this effect varied across the different beliefs. In particular, exposure to the corrective ad made consumers less likely to believe that there are health benefits from smoking light and low tar cigarettes.

The predictions in H4 to H6 concerned effects on consumers' confidence in their beliefs, constructs of interest

Figure 3

Differences in Belief Themes between Current Smokers and Nonsmokers



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in prior research in both marketing and psychology (Fazio and Zanna 1978; Marks and Kamins 1988). There was a significant effect of exposure to the ads, and the strength of this effect varied across different beliefs. These findings offered support for H4 and H5.

H3 and H6 predicted the use of graphic visuals in the ads, similar to those used on cigarette packages in Canada and Australia, would increase the overall strength of effects on the belief themes and belief confidence, respectively, compared to corrective ads not using visuals. For the belief themes, the results showed significant differences for health effects, addictiveness, and secondhand smoke. For respondents' confidence in their beliefs, results showed that the inclusion of a graphic visual to the corrective ad only had a significant increase for confidence related to health beliefs. Therefore, the findings for the addition of graphic visuals offered mixed results.

There are several implications of these findings that are relevant to *US vs. Philip Morris USA Inc.* (2006) and the recent ruling of Judge Kessler. The copy test findings of this research show that consumers' beliefs about smoking, in general, can be affected in a manner consistent with the objectives of the Court. Specifically, the exposure to the corrective advertisement had the strongest effect on the low tar and light belief theme, and significant effects on addictiveness beliefs, cigarette manipulation beliefs, and the health-related beliefs.

However, it should be noted that, although some of the belief themes were significantly affected by the corrective ads, many of the mean levels for these belief themes were already high. For example, for the control group not exposed to the corrective ads, means were above 6.0 for both health-related belief and secondhand smoke effects, and all means for beliefs are significantly above the neutral scale midpoint of '4' ($p < .01$). These results are consistent with those of the pilot study, where no ads were used. Despite past misleading actions and marketing tactics from the tobacco companies, these consumers do not appear to have strong levels of inappropriate beliefs about smoking and its consequences. Therefore, even though some beliefs show increases from the ad exposure, they may not be strongly affected because the respondents indicated such high mean levels in both beliefs and confidence already. Also, as shown in Figure 3, while the beliefs of current smokers are somewhat lower than nonsmokers, they also are above the scale midpoint. For smokers, beliefs about deceptiveness of the tobacco companies, health effects of secondhand smoke, and the low tar/light cigarette health benefits appear to offer the most substantial opportunity for positive changes.

Across all the study participants, it might be argued that the one belief in which there was some level of misperceptions or deception was related to the health benefits of low tar and light cigarettes. This is consistent with prior

literature that suggests some consumers have perceived health benefits of low tar and light cigarettes in the past (Kropp and Halpern-Felsher 2004; Kozlowski et al. 1998). Results found in this research show that this belief theme could be made stronger and confidence levels could increase through the use of a corrective advertising campaign. Thus, it might be argued that the most effective approach may be to weight any corrective campaign toward this low tar and light belief theme where the opportunity to 'correct' consumer misperceptions appears to be the most substantial. The campaign, however, could also continue to focus on other important beliefs identified in *US vs. Philip Morris USA, Inc.*, which clearly have implications for consumer welfare.

This study also assessed whether respondents' intentions to quit smoking were affected by corrective advertisements. Results showed that ad exposure had no significant effect on variables associated with smokers' intentions to quit. However, since the sample size only consisted of thirty-six smokers, larger sample sizes may provide a stronger test for these intentions variables.

Limitations and Future Research

There are several limitations of the research that may affect the generalizability of the findings. In this study, respondents only saw one sample advertisement (which was proposed to the Court as a possible corrective ad), either with or without graphic visuals. Other corrective advertisements could be used to test the same hypotheses, which may result in different findings. Additionally, as in most copy test advertising research, the research was conducted in a setting that differs from ad exposure in the natural environment. Results could differ if respondents saw the advertisements in more realistic conditions.

As mentioned above, a larger sample of smokers would provide stronger tests of possible effects on intentions to quit smoking and provide a better gauge of the effects of a corrective advertising campaign on the smoking population. Also, the sample consisted of university students. While this is one important target market for smoking research, future research should be extended to younger adolescents as well as older adults in the general public. In sum, further research to enhance the external validity of the findings should include broader samples, more practical ad exposure conditions, and use of different media rather than just print advertisements. Each of these would help extend results of this thesis research.

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Mentor Comments

Dr. Scot Burton describes the significance of Ms. Plack's research on cigarette advertising, praising her ability to juggle many aspects of her life while conducting this thesis project.

I am very pleased to have had the opportunity to supervise Brooke's work on a research project focusing on a recent case involving potential consumer deception and a federal judge's order regarding an extremely large corrective advertising campaign. As part of the ruling in US v. Philip Morris USA Inc. (2006), tobacco companies were ordered to make corrective statements concerning the health risks of smoking and secondhand smoke and their deceptive practices through newspaper and television advertising and on cigarette packaging. Brooke's thesis focused on initial tests of corrective print ads submitted to the Court in the case and their potential effects on the specific consumer beliefs identified in the case.

Her thesis research took Brooke into areas of law and the justice system, measurement theory, complex experimental designs, and statistics that often extended beyond her course work as an undergraduate student. I was extremely impressed with Brooke's high energy level, willingness to learn new concepts, and her level of curiosity throughout the various stages of her thesis. The results of her research have intriguing implications not only for this specific case, but potentially for the counteradvertising and public policy literatures, in general. As the head cheerleader at the University of Arkansas, Brooke had many demands on her time, and she had to balance the requirements of her thesis and other Honors coursework with extracurricular activities involving out-of-town games and SEC and NCAA tournaments. Her exemplary organizational and planning skills served her very well on this challenging project, and these attributes will help her in all of her post-graduation endeavors. Brooke also is highly motivated and self-disciplined, and she is a

very quick thinker who has excellent communication skills. I believe that she has an extremely bright future.

I commend Brooke for her outstanding effort and work throughout her thesis project.

Appendix A

Reliabilities and Multi-Item Belief Measures: Pilot and Main Study

Health effects (pilot test $\alpha = .91$; main study $\alpha = .85$):

- 1) Cigarette smoking causes lung cancer.
- 2) It is **not** likely that regular cigarette smoking will lead to heart disease.*
- 3) Cigarette smoking affects respiratory health and causes diseases such as emphysema.
- 4) Cigarette smoking is **not** related to the chance of stroke.*
- 5) Smoking by pregnant women increases the risks for fetal injury, premature birth, and low birth weight.
- 6) In general, smokers are **no** more likely to develop serious diseases, like lung cancer or heart disease, than non-smokers.*
- 7) Cigarette smoking causes many diseases, including lung cancer, several other cancers, coronary heart disease, and several respiratory diseases and conditions.
- 8) In general, smokers are as healthy as non-smokers.*

Addictiveness (pilot test $\alpha = .76$; main study $\alpha = .75$):

- 1) Smoking is addictive.
- 2) Nicotine is physically addictive.
- 3) Cigarettes and other forms of tobacco are **not** addicting.*
- 4) Pharmacology and behavioral characteristics that determine tobacco addiction are comparable to the determinants of addiction to such drugs as heroin and cocaine.
- 5) Nicotine is a drug that causes addiction to tobacco.

Low Tar and Light cigarettes (pilot test $\alpha = .91$; main study $\alpha = .93$)*

- 1) It is safer to smoke "low tar," "light," "ultra light," "natural," and "mild" cigarettes than it is regular brands.
- 2) Compared to regular cigarette brands, there are definite health benefits from smoking "low tar," "light," "ultra light," "mild," or "natural" cigarettes.
- 3) Compared to regular cigarette brands, "low tar," "light," "ultra light," and "mild" cigarettes reduce the chance of diseases related to smoking.
- 4) Smoking cigarettes with lower tar and nicotine levels provides benefits to health over smoking regular cigarettes.
- 5) Smoking cigarettes with lower tar and nicotine levels are safer to one's health than are regular cigarettes.
- 6) Light cigarettes are less harmful than regular cigarettes.
- 7) Smokers of light cigarettes take in less tar than smokers of regular cigarettes.
- 8) People smoking a cigarette labeled "light" will absorb just as much or more tar, nicotine, and carbon monoxide as when smoking a regular cigarette

Tobacco companies and cigarette manipulation (pilot test $\alpha = .87$; main study $\alpha = .82$)

- 1) Tobacco companies manipulated the design of their cigarettes to increase consumers' addiction.
- 2) I do **not** believe that tobacco companies purposely designed cigarettes so that they provide an addictive dose of nicotine.*
- 3) Tobacco companies control the amount and form of nicotine delivery in their cigarettes.
- 4) Tobacco companies did **not** intentionally influence the level of nicotine received from smoking cigarettes.*
- 5) Tobacco companies have manipulated cigarettes to make them more addictive.

Second-hand smoke (pilot test $\alpha = .88$; main study $\alpha = .92$)

- 1) Breathing smoke from someone else's cigarette is harmful.
- 2) Second hand smoke is dangerous to nonsmokers
- 3) Second hand smoke is **not** as dangerous as people make it out to be.*
- 4) Secondhand smoke kills people.
- 5) Exposure to second-hand smoke does **not** cause lung cancer in non-smokers.*
- 6) Exposure to second-hand smoke can cause heart disease in non-smokers.
- 7) Secondhand smoke does **not** cause disease and poor health in children.*
- 8) In children, secondhand smoke damages the lungs and causes sudden infant death syndrome (SIDS), respiratory and ear infections, and more severe asthma.

Tobacco Company Deceptiveness (pilot test $\alpha = .93$; main study $\alpha = .91$):

- 1) Tobacco companies try to get young people to start smoking.
- 2) Tobacco companies mislead young people into believing smoking is okay.
- 3) Tobacco companies mislead consumers on the effects of smoking on their health and others around them.
- 4) Tobacco companies use deceptive advertising and promotion to influence the perception of smoking to seem "cool" and "socially desirable."
- 5) Tobacco companies encourage people to start smoking.
- 6) Tobacco companies have used deceptive practices to get people hooked on smoking.

* These items are reverse coded. All the low tar and light cigarette items are reverse coded in order to make their direction consistent with the other belief theme items.

Appendix B

Condition 2 (copy only)

For decades, we deliberately misled the American Public about the health effects of smoking. A Federal District Court is requiring us to make this statement:

We told you that smoking and secondhand smoke were not dangerous and that smoking was not addictive. We falsely marketed "light" and "low-tar" cigarettes as less harmful than regular cigarettes to keep smokers from quitting—even when we knew they were not.

Here's the truth:

- Smoking kills 1200 Americans every day from cancer, heart attacks, and many other illnesses. It damages almost every organ in the body.
- Smoking is very addictive and therefore very hard to quit. We even manipulated cigarettes by adding things like ammonia to make them more addictive.
- There is no health benefit from smoking "light," "low-tar," "ultra-light," "mild" or "natural" cigarettes.
- Secondhand smoke is a proven cause of cancer, heart attacks, and other illnesses. It kills more than 38,000 Americans each year.

"Paid for by Philip Morris under order of a Federal District Court."

Appendix C

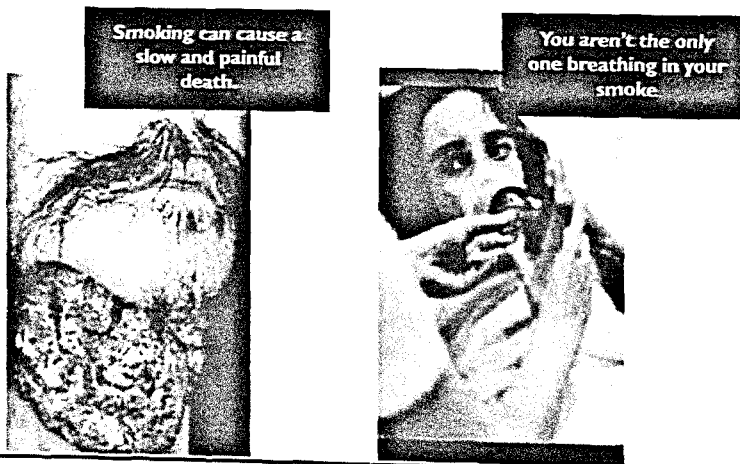
Condition 3 (copy with images)

For decades, we deliberately misled the American Public about the health effects of smoking. A Federal District Court is requiring us to make this statement:

We told you that smoking and secondhand smoke were not dangerous and that smoking was not addictive. We falsely marketed "light" and "low-tar" cigarettes as less harmful than regular cigarettes to keep smokers from quitting—even when we knew they were not.

Here's the truth:

- Smoking kills 1200 Americans every day from cancer, heart attacks, and many other illnesses. It damages almost every organ in the body.
- Smoking is very addictive and therefore very hard to quit. We even manipulated cigarettes by adding things like ammonia to make them more addictive.
- There is no health benefit from smoking "light," "low-tar," "ultra-light," "mild" or "natural" cigarettes.
- Secondhand smoke is a proven cause of cancer, heart attacks, and other illnesses. It kills more than 38,000 Americans each year.



"Paid for by Philip Morris under order of a Federal District

PREVERBAL LANGUAGE ABILITIES IN MONOZYGOTIC AND DIZYGOTIC TWINS

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Program in Communication Disorders

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Abstract

This study examined prelinguistic language development of twins by delineating: differences from developmental expectations; twin-twin communication and twin-mother communication differences; and monozygotic-dizygotic differences. Nine families with twins between seven and 16 months of age participated in the study. Five families had dizygotic twins, three of which were male/female pairs, and four families had monozygotic twins, only one of which was female. The primary caregiver completed a developmental history. Data consisted of Dore's Primitive Speech Acts (PSA) coding during in-home video-taping (30 minute sessions) with a second coding from the video material, and maternal reporting of vocabulary and communication using the MacArthur-Bates Communicative Development Inventory (CDI) for each twin. Variations were found between twin-twin and twin-mother use of PSA with all twins using more PSA with mothers. Dizygotic twins used more PSA overall and had better communication scores on the CDI than did monozygotic twins. Overall, results suggest that twins may be at a greater risk for language delay than singletons and monozygotic twins even more so.

The study of twins has contributed to the understanding of development in several ways. Identical twins (I), or monozygotic twins, are defined as twins that originate from one egg. Fraternal twins (F), or dizygotic twins, are defined as twins that originate from two separate eggs but share the same uterus. From a research perspective, twins provide a unique window to development because they share the same environment but can vary genetically (I/F) and/or by gender.

Sometimes twins are used as constants and variables in scientific studies. In such studies, one twin is given a certain stimulus while the other is left as the constant to see how the stimulus will impact such developmental issues as language. Twin studies have also been used as a comparison and/or contrast of development in twins versus singletons. Such was the case with a study by Day (1932) as well as one by Rutter, Thorpe, Greenwood, Northstone and Golding (2003). Each of these studies investigated the language development and delay of children by comparing the performance of singletons to twins. There have also been cases where researchers have compared development between fraternal and identical

twins. For example, Fischer (1973) as well as Munsinger and Douglass (1976) looked at the similarities and differences in the ways identical and fraternal twin pairs developed. Both of these studies looked at language development in terms of the specific aspects of language; Fischer (1973) compared all aspects, and Munsinger and Douglass (1976) looked specifically at syntactic abilities. Twins are particularly interesting when studying child language acquisition since research indicates environment influences language development (Fischer, 1973) and that twins frequently evolve a shared language code of their own (Malmstrom & Silva, 1986).

In research on the development of children in general (i.e., single children and not necessarily twins), there has been considerable investigation of development in the preverbal stage of infancy. This stage is usually six to 12 months of age and is characterized by vocalizations, such as babbling, and nonverbal communication, such as eye contact and meaningful gestures. One significant area of research involves primitive speech acts, which preverbally focus on the emerging use of sounds, voice and gesture for communication and then become verbal pragmatics. Primitive speech acts were adapted from the work of Austin (1962) and Searle (1969) by Dore in 1975 in order to analyze the communicative functions of infants at the preverbal and emerging language stages. "A primitive speech act might be a word, a change in prosodic pattern, or a gesture" (Hulit & Howard, 2002, p. 133). Dore found that young children used these speech acts to identify objects, reject objects, or to gain the attention of a specific person. The acts themselves, especially if they are gestures, have little semantic or syntactic relevance, and mainly serve a pragmatic purpose.

While differences in the development of the verbal aspects of language have been studied in twins, these early communicative acts characterized by Dore's work have not been the focus of past studies. It would seem reasonable that even these early aspects of communication development might differ from documented normal developmental patterns since: 1) twins reared together are constant communication dyads from birth; and 2) parents must divide their attention between the demands of two children as they move simultaneously through development. The goal of this study is to gain

information about the early speech acts of twins in the prelinguistic and emerging language stages of development in order to determine if differences may indeed be present even at this early age.

Review of the Literature

A literature review surveying twin language development was completed and is reported here. Both developmental studies and investigations of language differences are included. Because social communication shifts from being adult driven to child initiated somewhere around eight months of age (Owens, 2001), effort was made to include emerging language studies. However, this has apparently not been a focus of twin language research and there is little literature to review.

Munsinger and Douglass (1976) compared not only identical and fraternal twin pairs, but also the language development of their siblings, specifically looking at language skills due to genetics and environmental factors. Munsinger and Douglass studied 37 identical twin pairs and 11 of their siblings, and 37 same-sex fraternal twin pairs and 18 of their siblings. All participants were between the ages of 3 and 17 years and were found through Mothers of Twins Clubs in San Diego County. They used two different measures to test language and an intelligence test. Munsinger and Douglass concluded that identical twins had more similar language skills than fraternal twins. In addition, they found that fraternal twins and singletons develop language similarly.

In a study like this earlier work but with a language disorder base, Viding, Spinath, Price, Bishop, Dale, and Plomin (2004) looked at the genetic versus environmental causes for language disorders in twins. Participants were taken from an earlier study called Twins Early Development Study (TEDS). Participants included identical twin pairs, same-sex fraternal twin pairs, and opposite-sex fraternal twin pairs, all 4 years old with low vocabulary and grammar scores. The language test battery included nine different tests administered to each twin by a different tester to avoid biases. Viding et. al found that severe language impairment as opposed to more mild language impairment was usually influenced by genetics. It was also noted that more boys are impaired than girls. Again, environmental factors and genetics were studied to find the influence on twin language development in a study done by Kovas, Hayiou-Thomas, Dale, Bishop, Plomin, and Oliver (2005). This study also used participants from TEDS. In this case they were, on average, 4.5 years of age – some were within normal developmental ranges for control, and some had a measurable impairment. Each child was given a battery of verbal and nonverbal tests by a different tester to avoid biases. Kovas et. al tested the following aspects of language: expressive semantics, expressive syntax, receptive syntax, verbal memory, receptive phonology, and expressive phonology. They found that most aspects of language showed moderate

heritability and moderate influence of nonshared environment. The study also noted that they did not find significant differences between the development of boys and girls.

As referenced earlier, Rutter, Thorpe, Greenwood, Northstone and Golding (2003) compared the development of twins and singletons, hypothesizing that perinatal features may be the cause for language delay among twins relative to the development of singletons. The study had a participant sample numbering more than 80 twin pairs and about 80 singletons. The assessments were obtained in the homes and completed at 20 months and 36 months for all participants. The primary caregiver was asked to fill out a language assessment and a verbal functioning assessment. Also, each child was assessed in the areas of language, cognitive abilities, and short-term memory. The researchers looked at medical and birth history information as well as family background. While they found that twins' language was significantly behind that of singletons through the first three years, the cause of the delays was not associated with perinatal features. It is interesting to note that these findings of twin delay still applied after full adjustment for the tendency among twins to be born prematurely.

In research by Thorpe, Rutter and Greenwood (2003), twins were assessed in naturalistic environments to study causes of language delay. The study included 96 twin pairs born after at least 33 weeks of gestation and 98 pairs of singletons who were close in age. Each child was assessed in the areas of language and cognitive abilities, and their primary caregivers were given an assessment of maternal depression and verbal functioning. Home visits were conducted at 20 months and 36 months of the children's age, in which parent interviews were done as well as observations of parent-child interaction. Their findings showed that one possible reason for language delay in twins, as compared to singletons, may be the fact that parent-child interaction is markedly different in these situations. It is easy to see, for example, that parents of twins will be less likely to focus ample amounts of attention on both twins than they would when dealing with a single child. This is clearly one of the environmental factors that would affect language development and delay. Maternal depression proved irrelevant in causing language delay in either twins or singletons.

Malmstrom and Silva (1986) found evidence of a "twin language" in their study of one pair of identical twin girls. The data consisted of 31 hours of tape recorded conversation between the girls from the time they were two years old through 3 years, 9 months old. This specific study showed that the girls developed a special joint name for themselves, as well as the use of "me" and singular verbs when referring to themselves as a unit. Malmstrom and Silva concluded that the girls did not have an immature development of syntax, but used appropriate forms indicative of their twin status. Research on twin languages has shown that when this develops, normal language development is delayed. Twin

languages are more commonly found in identical twins, rather than fraternal twins, but even then it is very rare, or very rarely reported.

As can be seen from this literature review, language development in twins has been studied in a number of ways resulting in a variety of findings. There is an overall consensus that twins do often use a shared language that may or may not impact the developmental trajectory expected for normal acquisition. Noting that most of these studies focus on the magic years of language development (i.e., 24 to 48 months) it is not surprising that morpho-syntax and semantic variations are most frequently cited in the literature. It is less clear if twins exhibit differences in the six to 12 month age range when language is just emerging. It would seem reasonable that twinning might influence the pragmatic skills that infants use to bootstrap the development of language form and content since they might attend more to each other during joint attention tasks, and that the attention of parents may be more splintered due to the simple imperative to manage life as the babies become more mobile.

A credible way to study language ability in prelinguistic children is to look at their early understanding of language and socialized gesture as reported by parents and additionally as observed within familiar everyday activities. Calculating the number of words understood is a semantic measure, while looking at vocalizations and nonverbal communication is a measure of pragmatic development. Due to the lack of research in the literature on twins in the prelinguistic stage, it seems appropriate that a study should be done to investigate the speech acts of identical and fraternal twins. This leads to the specific questions of this study.

1. Do the prelinguistic skills of twins differ from developmental expectations during the second six months of life?
2. Do the speech acts of twins differ between use with each other and use with adults during the second six months of life?
3. Do prelinguistic skills differ between identical and fraternal twins during the second six months of life?

Methodology

Participants

Nine families with monozygotic or dizygotic twins between seven and 16 months of age participated in the study. No controls were used for social and economic background, race, birth order, or health problems. The families were given codes from 1 through 9 in order of the twins' age at the time of the study; all twin sets used in the study fell between the ages of the twins in Family 1 (7 months 21 days old) and Family 9 (15 months 24 days old). Of the families that participated, there were five families with dizygotic twins, three of which were male/female pairs, and four families with monozygotic twins, only one of which were females. Three sets of twins from the whole group were second in their family's birth order; all other sets were the family's first children, as seen in Table 1.

Table 1

Age, Sex, Zygosity, and Birth Order of Twin Participants

Dizygotic Twins				
	Age (month and days)	Sex	Zygosity	Birth Order
Family 1 - Twin A	7m 21d	Male	Fraternal	First
Family 1 - Twin B	7m 21d	Male	Fraternal	First
Family 3 - Twin A	8m 7d	Female	Fraternal	First
Family 3 - Twin B	8m 7d	Male	Fraternal	First
Family 4 - Twin A	8m 28d	Male	Fraternal	Second
Family 4 - Twin B	8m 28d	Male	Fraternal	Second
Family 5 - Twin A	9m 15d	Male	Fraternal	Second
Family 5 - Twin B	9m 15d	Female	Fraternal	Second
Family 7 - Twin A	13m 1d	Female	Fraternal	First
Family 7 - Twin B	13m 1d	Male	Fraternal	First
Monozygotic Twins				
Family 2 - Twin A	7m 25d	Male	Identical	First
Family 2 - Twin B	7m 25d	Male	Identical	First
Family 6 - Twin A	9m 23d	Male	Identical	First
Family 6 - Twin B	9m 23d	Male	Identical	First
Family 8 - Twin A	13m 7d	Male	Identical	Second
Family 8 - Twin B	13m 7d	Male	Identical	Second
Family 9 - Twin A	15m 24d	Female	Identical	First
Family 9 - Twin B	15m 24d	Female	Identical	First

As reported by the mothers on a developmental history form, six of the nine sets of twins were born prematurely (i.e. before 37 weeks gestational age). As seen in Table 2, many of the participants remained in the neonatal intensive care unit (NICU) for some length of time, though health problems were minimal among the participants.

Table 2

Health Status of Twin Participants

Dizygotic Twins			
	Gestational Age	NICU	Health Issues
Family 1 - Twin A	34 weeks	10 days	Acid reflux
Family 1 - Twin B	34 weeks	10 days	Acid reflux
Family 3 - Twin A	34 weeks	14 days	Reflux
Family 3 - Twin B	34 weeks	14 days	Reflux
Family 4 - Twin A	35 weeks	14 days	Immature lungs
Family 4 - Twin B	35 weeks	14 days	None
Family 5 - Twin A	40 weeks	0 days	None
Family 5 - Twin B	40 weeks	0 days	None
Family 7 - Twin A	37 weeks	0 days	None
Family 7 - Twin B	37 weeks	0 days	None
Monozygotic Twins			
Family 2 - Twin A	35 weeks	12 days	None
Family 2 - Twin B	35 weeks	12 days	None
Family 6 - Twin A	33 weeks	35 days	None
Family 6 - Twin B	33 weeks	35 days	None
Family 8 - Twin A	34 weeks	28 days	None
Family 8 - Twin B	34 weeks	28 days	None
Family 9 - Twin A	40 weeks	0 days	None
Family 9 - Twin B	40 weeks	0 days	None

Procedures

Information about the study and a request for volunteers was distributed through doctors' offices and parenting networks (e.g. Mothers of Multiples Groups) in northwest Arkansas and Sugar Land, Texas. Interested families contacted the researcher by e-mail and the study was explained using an IRB approved script.

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The study was conducted in the homes of each participating family. Parents were asked to fill out a brief developmental history for each child prior to meeting with the researcher. This served to document each twin's developmental status at the time of the data collection. Each family in the study was video taped participating in familiar play activities. The researcher adapted the video taping sessions in a variety of ways to fit each family's preferences and comfort levels as was appropriate. With some families, there were three distinct parts to the video taping: the twin set interacting together in their playroom for approximately 10 minutes; the mother and Twin A interacting in the playroom while Twin B was entertained by a third party in a separate room for 10 minutes; and then the mother and Twin B interacting in the playroom for 10 minutes while Twin A was entertained by a third party in a separate room. With other families, the separate sessions were not so deliberate or divided. The video data collected with these participants was 30 minutes of twin-twin interaction, twin A-mom interaction, and twin B-mom interaction randomly dispersed throughout the session. Finally, in a third scenario, the mother was constantly present with the twins and she was observed predominantly interacting with Twin A, interspersed among the twin-twin interaction. In these situations, a third party would remove Twin A from the playroom after 20 minutes to allow for distraction-free Twin B-mom interaction. In all cases, a minimum of 30 minutes of video recordings were obtained.

Following the video recording/observations, the parents were asked to fill out the MacArthur-Bates Communicative Development Inventory (CDI) for each child in order to document their language development status. All participants returned the completed forms to the primary researcher by mail within one to two weeks of the recording session except for Family 9. These twins were recorded at 15 months and 24 days of age, but the primary caregiver did not return the CDI form until the children were almost 18 months old.

The play activities for all participants utilized toys that the children were already familiar with in order to provide more natural opportunities for primitive speech acts (i.e., requesting, labeling, protesting). A coding sheet using Dore's Primitive Speech Acts (PSA) categories was designed by the researcher so nonverbal, vocal and/or verbal engagement with these speech acts by each of the participants could be documented. The use of speech acts was coded during the actual data-gathering session and then checked by viewing the recordings. A second coder reviewed and independently coded 25% of the video material using a description sheet that described each of the speech act categories. There was 90% agreement between the primary researcher and second coder.

Analysis

Information gathered from each family's history form was collapsed into a table that summarized health and

developmental status. The presence or absence of each speech act category and the mode of communication (nonverbal, vocal, verbal) for each twin as well as the primary caregiver were summarized for each family. In addition, the CDI was scored and interpreted into percentages or percentiles according to the test manual. This information was then collapsed into tables that allowed each question of the study to be addressed.

Results

In order to look at the results of the study more easily, the 9 participating families will be divided into 3 groups according to the age of the children. The first group, Group A, will be made up of Family 1, 2, and 3 – all of which are about 8 months old. The second group, Group B, will be made up of Family 4, 5, and 6 – all of which are about 9 to 10 months old. Group C will be made up of Family 7, 8, and 9, the oldest group, who were between 13 and 16 months of age. These three groups will be used to help answer questions one and two. The natural division among the families, those who have monozygotic twins and those who have dizygotic twins, for each data set was used to answer question three.

Question #1

The first question of the study asked if the prelinguistic skills of twins differ from developmental expectations during the second six months of life. This question was answered by looking at each child's results from the CDI and the PSA coding. Vocabulary comprehension and production scores and early gestures scores on the CDI are recorded in percentiles that correspond to the age and sex of the child and how many words the mother reported that each child understood and produced or how many gestures the child had at the time of the study. In Table 3, these percentile scores have been converted into a developmental status of either "within normal limits" (WL) or "at risk" (AR) using the normal distribution curves and research information in the test manual. According to the manual, vocabulary production scores are not the best predictor of later language delay. In fact there is evidence to show that a child with delays in comprehension, production, and gestures will be "at greater risk for persistent language delay than a child with an expressive language delay alone" (Fenson, Marchman, Thal, Dale, Reznick, & Bates 2007). With this information, the researcher decided to give an "at risk" rating if the child's scores were in the 15th percentile or below in two or more areas. Below, Table 3 shows that three of the nine families were identified as at risk by these guidelines and the other six families were all within limits for their age.

Each primitive speech act was coded from the PSA form as either being present or absent as observed by the researcher in the time spent with each family. The speech acts coded were greeting, calling, labeling, answering, requesting an object, requesting an action, protesting, and imitating. Each act was coded as being nonverbal, vocal, or verbal. Many of

Table 3

Early language development in percentiles as reported on MacArthur-Bates Communicative Development Inventories

Dizygotic Twins				
	Vocab Comprehension	Vocab Production	Early Gestures	Dev Status
Family 1 - Twin A	25	85	45	WL
Family 1 - Twin B	25	85	45	WL
Family 3 - Twin A	85	40	45	WL
Family 3 - Twin B	90	55	60	WL
Family 4 - Twin A	40	55	25	WL
Family 4 - Twin B	40	55	25	WL
Family 5 - Twin A	65	75	50	WL
Family 5 - Twin B	60	65	60	WL
Family 7 - Twin A	35	65	25	WL
Family 7 - Twin B	40	45	35	WL
Monozygotic Twins				
Family 2 - Twin A	70	55	5	AR
Family 2 - Twin B	70	55	5	AR
Family 6 - Twin A	15	55	5	AR
Family 6 - Twin B	15	55	5	AR
Family 8 - Twin A	25	55	45	WL
Family 8 - Twin B	35	55	60	WL
Family 9 - Twin A	20	<1	<1	AR
Family 9 - Twin B	20	<1	<1	AR

Figure 1

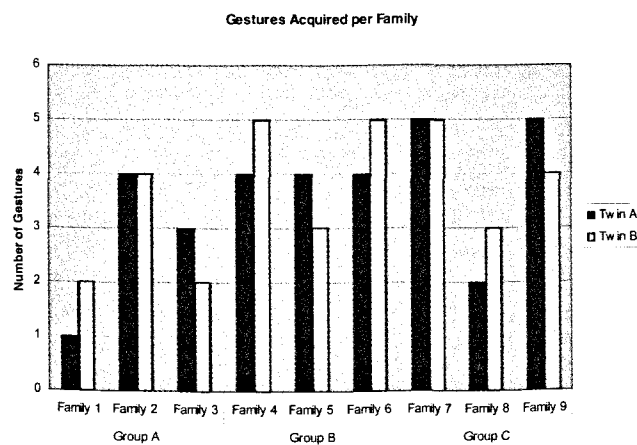
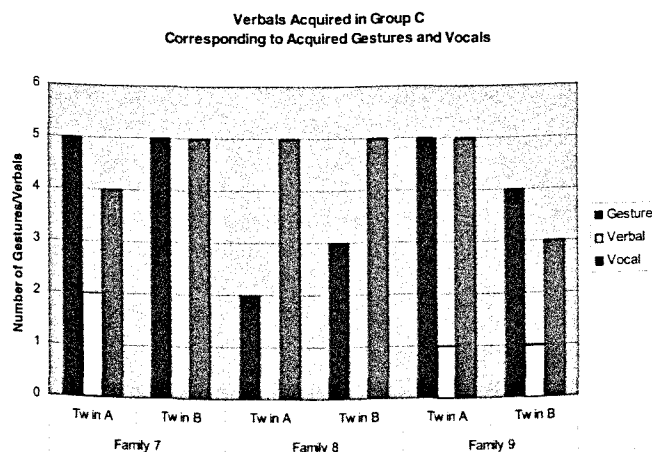


Figure 2



these speech acts correlated with some of the early gestures reported on the MacArthur forms. In this way, it was possible to compare parent-reported gestures and researcher-observed gestures. According to normative information about child language development (Paul, 2001), children between the ages of 8 and 12 months should be using the following five gestures as pragmatic acts: requesting objects and actions, protesting, imitating, and labeling. Paul also reports that children between 12 and 18 months of age should develop verbalizations to accompany and/or replace these gestures. In Figure 1, the five gestures were considered developed if the child had produced each gesture nonverbally (i.e. a true gesture without a supporting sound). The majority of twins in each family were using at least three of these five gestures.

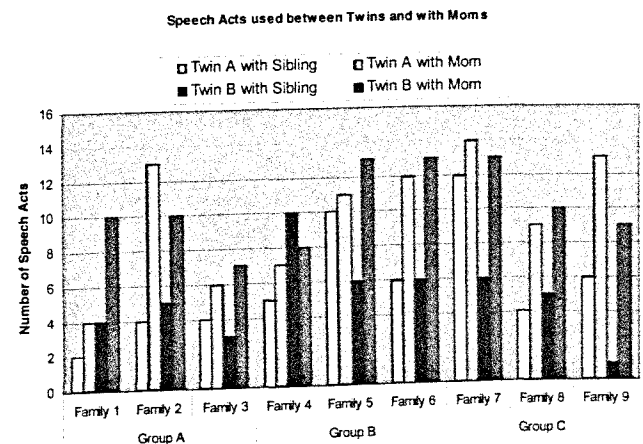
In Figure 2, the number of verbals acquired for each twin in Group C (out of the five reported by Paul) were compared to the number of nonverbals acquired. This figure only examines the results from Group C because this is the only group with children above 12 months of age. Because so few verbals had been acquired in this group, the number of vocals was added to the figure so it could be seen that, although the children were not using verbalizations for primitive speech acts, they had progressed to using meaningful vocalizations to accompany their gestures.

Question #2

The second question of the study asked if the speech acts of twins differ between use with each other and use with adults during the second six months of life. With one exception, twins consistently used more speech acts with their moms than with their sibling.

In Group A, each twin used more speech acts with their mother than with their sibling. In Group B, two of the families had similar numbers of acts with their siblings as with their mothers and in the third family, Family 6, each twin had at

Figure 3



least twice as many speech acts produced with mother as with sibling. In Group C, only one twin in one family had similar use with mother as with sibling. The twins in Family 8 and 9 used many more speech acts with their mother than they did with their sibling. In each of the three groups, the twins seemed to use different speech acts with their mother than they used with their sibling, but some families showed that the twins used a considerably fewer number of speech acts during twin-twin interaction as compared to twin-mom interaction.

Question #3

The third question of the study asked if prelinguistic skills differ between identical and fraternal twins during the second six months of life. To best answer this question, all data in the tables was arranged into two groups: dizygotic twins and monozygotic twins. In Table 2 it can be seen that, on average, the identical twins had fewer health problems but longer hospital stays, as compared with the fraternal twins. Table 3 shows that all six twins with an at risk developmental status are identical, as compared with all fraternal twins being within normal limits. Only one set of identical twins was within limits. In Figure 4, there is a considerable difference in how many speech acts identical twins use with each other and how many they use with their mothers. Though all twin sets used more speech acts with their mothers than with their siblings, identical twins showed this pattern consistently and to a greater degree. Fraternal twins displayed less of a difference in the number of speech acts they used in each situation.

Discussion

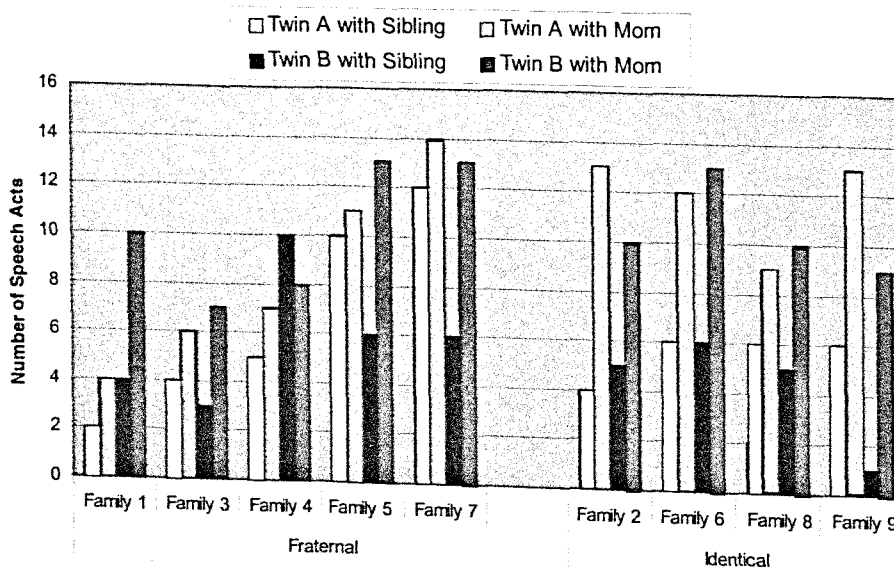
Monozygotic twins, as compared to dizygotic twins, seem to have greater developmental communication differences. Data from the CDI show this most clearly; three of the nine families had twins with a developmental status of at risk, and all three of these families had identical twins. Only one set of identical twins, Family 8, was within limits. This twin set had one obvious difference that set it apart from the other identical twins in the study; they were second in the birth order of their family. This may have given these children an advantage, as their parents would have more infant communication experience and an older peer was present for child talk modeling.

For the majority of the participants, the number of gestures observed fell below the developmental expectations as reported by Paul (2001). Paul's normative information indicates that children in this age group should have developed five specific gestures, but only five children in this study had these developed as observed by the researcher. The majority of the participants had at least three of these gestures at the time of the study. Paul also indicates that children in a 12-18 month age group should have developed verbalizations to replace these gestures. Of the six children of this study that fell within this age group (i.e., 13 to 15 months of age), three had only one verbalization developed and the other three children had no verbalizations to go with their gestures. All of these children had developed vocalizations to accompany these gestures. Since these children are all over thirteen months of age and first words usually emerge between 10 and 14 months, the language development of the twins in this study parallels studies that suggest that twins have a different rate of early language growth (Day, 1932; Munsinger & Douglass, 1976; Rutter et al., 2003).

A very interesting pattern emerged when the use of speech acts between monozygotic twin pairs and those of monozygotic twins with their mothers were compared with their dizygotic twin counterparts. A close look at Figure 4 shows that monozygotic twins use considerably fewer speech acts when interacting with their twin than when interacting with their mother. A possible explanation for this is that identical twins are more likely to develop a shared language (Malmstrom & Silva, 1986). This language may allow identical twins to communicate with each other independent of the primitive

Figure 4

Speech Acts comparing Fraternal and Identical Twins



speech acts coded by the researcher. This explanation is even more likely based on the observation that the identical twins in this study had many vocalizations that were not interpretable. These vocalizations could be precursors of what will become a shared verbal language. One mother of identical twin girls spoke candidly on this very idea after being observed: "Sometimes I will wake up in the morning and listen to the girls on my baby monitor. They will babble back and forth for several minutes and then burst into laughter, and I have no idea what was so funny." This is the same mother that reported the following answer to the question 'how do you know if your child wants something' on the developmental history form: "points, signs, or grunts and I just know." This is perhaps the key to the development and maintenance of a twin language. These girls have obviously found a way to communicate with each other without using speech, and they have trained their mother to adapt to their communicative code instead of being forced to adapt to hers. As reported by their mother, the girls did not have any verbal production, though the researcher observed each girl to have one indefinite article: this and that, produced more like 'di' and 'da', respectively.

In comparison, dizygotic twins seem more likely to fall within normal developmental expectations. On the CDI, all dizygotic twin pairs had scores within normal limits for their age. Fraternal twins also seemed to produce more speech acts with their sibling than identical twins. With respect to the acquired gestures and verbalizations expected by this age, fraternal twins had development patterns similar to their identical counterparts.

Limitations of the Study

There are several limitations that impact the results and generalization of these findings. First, the choice was made to collect naturalistic data. As a result, video taping activities and sequences between mother and twins were adapted to families rather than being strictly controlled. Another limitation was the short amount of time the researcher was able to observe each family. A thirty minute observation time on a single day provides insight of a limited nature. For example, in one set of twins a child was miserable because of teething and in another, a child had a cold. These very real aspects of baby-life could have impacted the kinds of speech acts used between twins as well as with the mothers. And finally, a major limitation of this study is the participants. Nine families is a small number from which to obtain conclusive results. Additionally, the families were self-selected in that they volunteered for the study. As a result, there was no identifiable diversity with regard to social economic status, race or ethnicity.

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Mentor Comments

Dr. Fran Hagstrom, Ms. Albrecht's research mentor, made the following remarks:

It has been a joy to work with Sara and see her develop as a scholar over the last two years. Her Honor's thesis, Preverbal Pragmatic Abilities in Monozygotic and Dizygotic Twins, that appears in this journal is a well conceptualized first piece of research that has grown

out of her interest in the research basis for clinical action in speech-language pathology.

Sara combined her educational background in child development and language acquisition with the life experience of being a twin to organize her research program. This included an extensive review of the child language literature where developmental language differences in twins are widely reported. Working from this, she designed a study to determine if twins display unique communicative features prior to the emergence of spoken language. Her idea to investigate the prelinguistic foundation of language by looking at dyadic interaction between twins and between individual twins and their primary caregiver was particularly innovative.

Innovation is often a metaphor for difficult and complex, which was the lived experience in this case. Small numbers of children are used in studies of early language because the data is often difficult to obtain, and the analyses are time consuming because they are complex. Nine families allowed Sara to come into their homes and study their children, all of whom were eight to 18 months of age. Thirty minutes of video recording was collected in each home, and mothers completed a brief developmental questionnaire and a vocabulary inventory for each twin. This is a remarkable data set with numbers of participants

that meet or exceed many published studies of young twins. The analysis of non-verbal video data is an arduous process that requires multiple cross checks. The process consumed nights and weekends for weeks on end. Yet Sara's motivation and desire to work with this project continued to be energized as she analyzed these data for developmental patterns. In the end, as readers can see from the article, differences were found in the prelinguistic communication of twins. This is a significant developmental finding that will contribute to scientific knowledge about language development in twins. Thus, Sara's data collection and analysis stand out as remarkably thorough, grounded and equal to other studies published in child language journals.

It should be noted that this is original research rather than an extension of a faculty project; that Sara completed each step of the process needing only guidance and mentoring support; and that the caliber of this research is at a graduate rather than an undergraduate level. This last comment was made to Sara by several scholars after her peer reviewed presentation at the national convention of the American Speech-Language-Hearing Association. It also speaks to the merit of her research, which was supported by both Honor's College and SURF funding. Her final honor is seeing her first research effort in print and in Inquiry.

IMPROVEMENT TO THE DATA LOGGING CAPABILITY OF A COUGH MONITORING SYSTEM

By Matthew Barlow

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and

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Abstract

Data logging capability of a previously developed self-contained cough recorder using an accelerometer as the sensing element is improved by using a secure digital memory card for later retrieval on a computer. Firmware is developed to enhance the functionality of the cough recorder. Existing libraries are modified for increased write rates. Increased writing speed allows 8-bit sampling at rates exceeding 8kHz, allowing for detailed time and frequency domain analysis. Additional features have also been developed to enable easy management of recordings, such as a file system compatibility with Microsoft Windows., and unique file names for each recording.

1. Background

Coughing is a common reflex mechanism to clear blockages of the windpipe. As such, it is also a general indication of unhealthiness. The presence of a cough is a reason for consulting a doctor, purchasing over-the-counter cough suppressing medicine, and visiting a hospital. In 1995^(I), 19 billion dollars were spent on over-the-counter cough and cold remedies. However, studies have shown that the effectiveness of cough medicine is comparable to placebo. These studies often lack uniform and quantitative methods for recording and analyzing coughs in subjects.

Previous efforts towards recording coughing include the system developed by Hsu *et al*^(II), which used a unidirectional microphone and electromyograms to determine when the patient was coughing. This method obtained good results in detecting coughs, but with the 50Hz sampling rate, a detailed reconstruction of coughs was not possible. Jaeger *et al*^(III) developed a system that correlated data from a microphone, an accelerometer measuring movements and vibrations from the throat, and an electromyogram to sense muscle movements. This system was effective in rejecting interference, but required the patient to be stationary in a laboratory environment. Requiring the patient to stay in a laboratory adds to the cost of a study and reduces the convenience to the patients. Subburaj *et al*^(IV) produced a device using an accelerometer attached to a radio transmitter. The RF signal was then received by a large base station for recording. The device allowed the patient to

move around, but required a large recording unit to function, and limited the range of the patient's movement. In addition, the transmitting unit was heavy and unsuitable for use with children. The analysis software provided no automation, requiring the user to play back the entire recording to analyze the recorded data.

2. Previous Research

To alleviate this need, Jewell^(V) developed a prototype compact, self-contained cough recorder with Matlab-based analysis software. The device consisted of a MEMS accelerometer for the sensing of coughs, and a PIC microcontroller digitizing samples and storing the samples to a Compact Flash (CF) memory card. This approach was unique in using a calibrated accelerometer to accurately measure cough effort and magnitude in a self-contained ambulatory unit. The accelerometer was taped to the patient's suprasternal notch. Privacy was maintained for the patient since the accelerometer did not record ambient noise, and a low pass filter removed most components of speech. The device was ultra-portable, and was powered by a 9-Volt battery. The recording time varied based on the memory card used. The minimum size supported - 32 megabytes - allowed about 66 minutes of recording time, while the largest card supported allowed just over 17 hours. Software was provided to enable frequency and time domain analysis, as well as viewing the cough signal envelope. The Matlab software could also automatically remove periods of silence from the recording, and do limited categorization of the remaining signals. The validity of this method of recording was confirmed by Paul *et al*^(VI) in a study comparing the accuracy of the cough monitor and a video recording. The result showed good agreement between the cough counts recorded on video and by the cough monitor.

While the recording device was indeed revolutionary, the recorder was not optimized for small size. Only some brands of CF memory cards could be used with the existing firmware, and the product was not "finished." A new cough recording device was developed by Varadan^(VII) that was smaller and more versatile than the device designed by Jewell^(V), while maintaining compatibility with the Matlab analysis software.

Key improvements included a more compact circuit design, lower voltage requirements, and usage of a physically smaller memory card.

The entire package with sensor weighs less than 50 grams. Because this device is small and lightweight, it is ideal for use in pediatric studies. The accelerometer sensor provides multiple benefits to the system. By only sensing movement of the vocal cords, ambient noise is efficiently filtered out. Also, taping the accelerometer on the suprasternal notch of the patient reduces the speech content recorded, which increases the privacy of the patient, and allows for simpler signal processing requirements for automated cough detection. The cough monitoring device is also completely self-contained. This provides an advantage over a wireless transmitter and base station because there is no range restriction, or multiple devices to manage.

The improved cough monitoring system uses a PIC 18F6722 microcontroller to record data from an internal A/D converter, as shown in Figure 1. This circuit is fed by a fourth-order low-pass Butterworth filter network and a gain stage. Cough sensing is done through a MEMS accelerometer. Both the filter and the accelerometer circuitry is reused from the previous design. The input signal is sampled at 8 kHz and stored on a SD memory card. The SD card is connected through the Serial Peripheral Interface (SPI) built into the microcontroller.

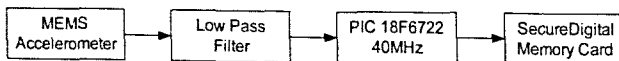


Figure 1 – Hardware Block Diagram

3. Hardware/Firmware Development

The focus of the research described in this article was the development of the firmware necessary for full operation of the improved cough recording device. This involved performing basic user-interface functions, sampling the output voltage of the accelerometer at a fixed sample rate, and recording all samples to the removable memory card. The functional requirements involved recording analog data at a rate of at least 8000 samples each second, and recording all samples in a format that can be accessed by any computer equipped with a Secure Digital card reader. Firmware programming was done in C using the Custom Computer Services Windows IDE.

In order to write the analog samples to the SD card, the Progressive Resources Flash File library was implemented. This library enables the microcontroller to write data to a SD card through the SPI interface, making a FAT16 file system that is easily accessible by computers. Without modification, the Flash File library lacked the data rates required for the cough monitor. By simplifying the expected running conditions, it was possible to remove several time consuming

file system checks and safeguards. These checks are necessary for ensuring that the file system is always updated, and that other files on the SD card are preserved in the event of a sudden power loss, or removal of the SD card. With these safeguards in place, the highest consistent writing speed was 4 kB/s. After removing the safeguards, write speeds between 17 and 22 kB/s are typical. The library was also modified to use four write buffers to allow for potential temporary slowdowns encountered while writing data to the SD card.

The power for the device is controlled by a switch built into the SD card socket. When no SD card is present, power is removed from the circuit. This prevents inadvertent power dissipation while the device is not in use, and also ensures that a SD card is always connected during operation. Power is supplied by two 3.6V Lithium primary batteries, size ½ AA. These batteries are currently estimated to give a battery life between 17 and 24 hours, depending on the model of the battery and the model of the SD card. Three light emitting diodes are visible outside the case, which are used to provide status indication to the user.

The PIC microcontroller uses an on-chip program memory, which starts the execution of the firmware, as shown in Figure 2, upon the insertion of a SD card. When a SD card is inserted into the socket, the microcontroller powers on and reformats the SD card. This ensures that the file system is not fragmented and that the maximum amount of space is available. After formatting the SD card, the device generates the file name for the current recording session. The device ensures that all file names are unique, and convey two pieces of information. An example of the file naming convention is: "X_005038.dat", where 'X' is the unique device identifier, and '005038' is a unique recording serial number that is incremented every time a new recording file is created. The file serial number is stored in EEPROM to maintain the data after power is disconnected. We envision each device would be labeled with a letter corresponding to the device identifier in the file name. This would allow easy tracking based on the recording device for statistical purposes. Since no recording will have the same name, this makes the file name a viable primary key in a database. No file renaming will be necessary if the recording files were placed in the same directory. Unfortunately, to achieve this flexibility for the end user, each device must be uniquely programmed with a device identifier. After the file name is generated, interrupts are allowed, and the main program loop is activated. This loop writes buffers to the SD card as soon as the buffers are full, and maintains correct write order of the buffers.

Samples from the accelerometer are taken every 125µs, or at a rate of 8000 samples per second. The sampling routine is run from an interrupt that is generated from a hardware timer overflow. The time delay is easily changed by changing the reset value of the timer register. After reading the value on the ADC, a level shifting is performed on the 10-bit result to

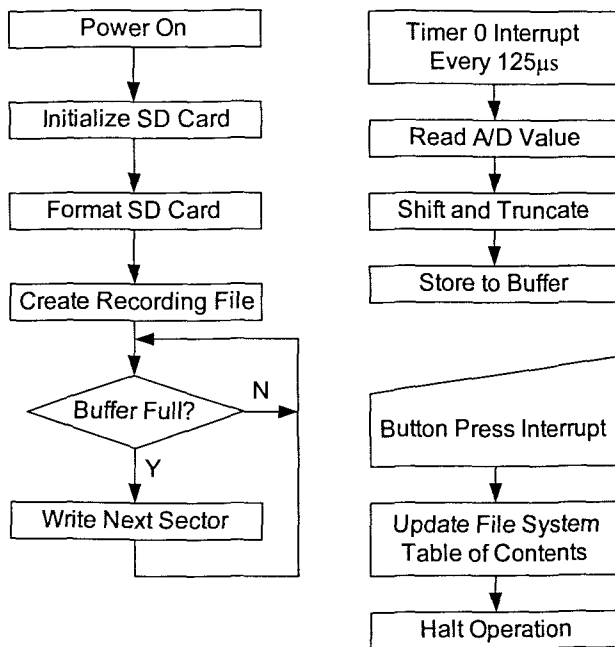


Figure 2 – Flowchart of Firmware operation

center the steady state value to 128. After this level shifting, the result is checked for values outside the range of 0 to 255, and any samples falling outside the window are stored as either 0 or 255 to indicate a clipping condition. If the sample falls within the sample value window, the two most significant bits are removed, and the result is stored as a 8-bit sample. Using an interrupt to initiate recording from the analog to digital converter allows the lengthy write routine to process in the background without missing any samples. The minimum amount that can be written to a SD card at a time is 512 bytes. Data is buffered in 512-byte sectors for direct writing to the SD card. Four buffers are allocated in memory, allowing for a temporary interruption lasting up to 0.25 seconds. This level of buffering was found to be necessary to maintain certain levels of file system integrity. The current SD cards are 512 megabyte units, which are able to hold over 17 hours of recorded data.

After the recording session is completed, the user is instructed to press the button located on the circuit board. The button is accessible from the exterior of the case via a hole above the button in the plastic shell. This prevents accidental pressing of the button, which would prematurely end the recording. After the button is pressed, the Table of Contents of the file system is updated to reflect the current file size. The system is then suspended, and the SD card is safe to remove. If the SD card is removed before the button is pressed, the data file will have a length of zero, and recovery of the data will be difficult.

One requirement of this device is that the data recorded should be easily accessible by a personal computer after the recording session is finished. Thus, an implementation of the FAT16 file system was chosen for simplicity. After a file is created on a FAT16 file system, data is written in 512 byte sectors, and 16 consecutive sectors make up a cluster. The number of sectors in a cluster is determined by the size of the SD card. In a 512 megabyte card, 16 sectors are in one cluster, while on a 1 gigabyte card 32 sectors are in one cluster. Each cluster on the SD card must be accounted for in the cluster table of the FAT16 file system. The cluster table maintains a linked list of clusters for every file, and also keeps track of unused clusters. The exact file size is stored in the Table of Contents of the file system. This is the value that Microsoft Windows uses to determine the file size to display. If the cluster table and Table of Contents are not in agreement, the file will be corrupted. To date, we have been unsuccessful in performing updates to both the Table of Contents and the cluster table in real-time recording conditions. The compromise employed maintains the cluster table in real time, and updates the Table of Contents of the file system after the recording is finished. Only one brand of SD card has been tested successfully so far.

Current management of recordings is manual. Ideally, data management software would be used to automatically log times and dates associated with recorded files. Additional data, such as subject ID, start and stop times of the recordings, and additional notes and analysis of the recordings could be stored in a database. This would allow easier tabulations of results, as well as providing a simplified software interface for researchers.

4. Analysis of Output Waveforms

Previous work by Jewell ^(V) indicated that coughing is distinct from other signals recorded in this manner. To demonstrate that the input signals are distinct, three waveforms are given for three separate actions. The actions performed include speaking, clearing the throat, and coughing. The following pictures show the data recorded using the cough monitoring device.

When the accelerometer is attached to the suprasternal notch, vibrations from speech are minimized. The low-pass filter network also removes many components of voice, which is necessary to protect the privacy rights of the subject and ensure that no speech is recognizable from the recorded data.

Figure 3 shows a typical envelope for clearing the throat from a signal recorded from the cough recorder. This action is easily distinguishable from silence or speech in a recording. Key features include a sustained envelope of the signal, with a gradual tapering of the envelope. Figure 4 shows a typical cough waveform. As the cough begins, the envelope rapidly increases, followed by a decrease in energy. A second peak follows. Coughs consist of two or more surges, and have

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rapid rise times on the initial surge. These two indicators assist the automated software in detecting coughs.

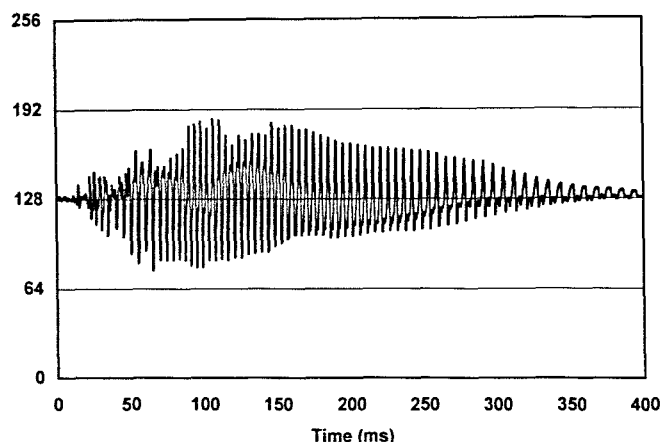


Figure 3 – Time domain signal of 'Clearing Throat' from the recorded secure digital card data

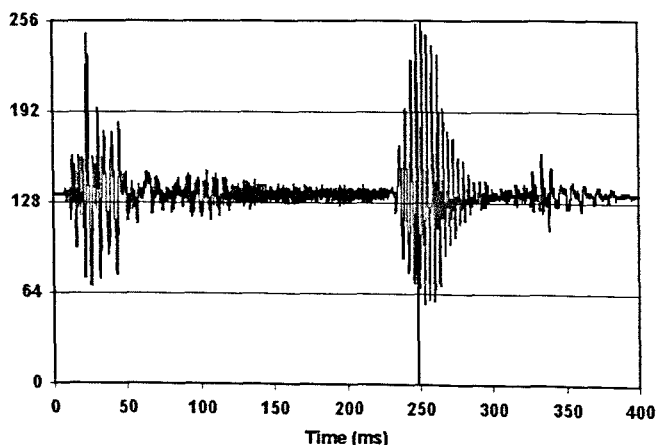


Figure 4 – Time domain signal of 'Cough' from the recorded secure digital card data

5. Conclusion

Firmware has been successfully developed to achieve the required design objectives. The device correctly filters and samples the accelerometer values. However, recording data has proven to be difficult with the SD technology. Writing non-sequential sectors, such as the file system cluster table and the Table of Contents have caused tremendous slowdowns. This results in gaps in the recorded signal, which is generally unacceptable. Buffering is used to attempt to compensate for unexpected delays while updating the cluster table. This requires the user to press a button before removing the SD card, and unexpected removal of the SD card leads to data loss.

Other problems come from limited storage space. Although currently not a problem, the size of the memory card limits the maximum recording time. One possible solution is a compression technique called run length encoding (RLE). This compression technique takes advantage of fairly constant data when the accelerometer is not moving. This will increase the time between sector writes, which results in lower power consumption and the possibility of automated file system updating. Since the device is battery operated, power consumption is a major concern. The operating frequency of the microcontroller can be reduced, offering lower supply voltages, and less power consumption. Reducing the number of reading and writing operations will also save considerable amounts of power. Furthermore, the device does not work with different varieties of SD cards. Further research and development will overcome these limitations.

Acknowledgement

We would like to thank Dr. Ian Paul, MD (Hershey Medical Center, PA) for his support throughout the project

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Mentor Comments

Much of the development research that occurs in some engineering disciplines requires teamwork and continuing improvement of products and systems. Professor Vasundara V. Varadan describes how he and Professor Jia Di supervised the unique and important research initiatives of Mr. Barlow.

As background, I started this project while I was on the faculty at Penn State and worked on this device

at the request of Dr. Ian Paul, Professor of Pediatrics who wanted a device to undertake clinical trials on the efficacy of cough medicine as prescribed for children today. A prototype, fully functional device was developed at Penn State under my supervision by my graduate student Steven Jewell who wrote his MS thesis on the topic (2003). Since coming to this University, I have developed a more compact, factor of 2.5 smaller and lighter, self contained cough recording system. A secure digital card was designed for use with the system, since it is available more commonly from a variety of vendors and is available with 2-3 GB capacity. However, the standard protocols it uses for data writing make the data logging speed far below the 8 kHz rate that is required for recording high quality cough data. The important contribution that Mathew Barlow has made in its evolution and improvement, is that he bypassed the standard protocols provided by the SD card manufacturer and developed his own software and firmware so that we can still achieve an 8 kHz sampling and writing rate using the SD card. This is described in the paper submitted to Inquiry with output

data confirming that his software and firmware are successfully recording signals at the correct sampling rate. Matthew wrote the paper on his own with editorial help only from Prof. Jia Di and myself. One device was sent to Dr. Ian Paul for evaluation and he has responded that it is working satisfactorily.

The significance of this device cannot be overstated. Cough is the most common reason why parents take their children to a doctor. Cough medicine is a 19 billion dollar market in the USA. Yet, Dr. Paul's qualitative studies already indicate that cough medicine is no more effective than honey. The media interest in this has been great. Dr. Paul has been interviewed by many newspaper, cable and network TV stations as well as the BBC. I think that the current device will enable a more scientific clinical trial that will firmly establish the efficacy of cough medicine for the prevention and cure of coughing. The device as developed now is commercializable and could also be adapted for other uses.

THE UNSETTLING LANDSCAPE: LANDSCAPE AND ANXIETY IN THE GARDEN OF THE HOUSE OF OCTAVIUS QUARTIO

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Classical Studies

Faculty Mentor: David Fredrick
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Abstract

Ancient Roman houses (*domus*) were both public and private spaces and were used by the homeowner (*dominus*) to send messages of power to his guests and family members. Scholarly analysis of the rhetorical power of the architecture and decoration of the *domus* has largely overlooked the role of the garden within this context. It is generally assumed that the purpose of the garden was to provide a calm green space in the center of an urban home. The purpose of this paper is to challenge this overly simplistic reading of Roman gardens and to explore how the *dominus* might have used this space in a much more complicated way, to affirm his power in his home and in Roman social hierarchy by alternately reassuring and unsettling his guests. Consequently, this paper will first briefly examine the background of natural landscape in literature and myth, and then it will elucidate the rhetorical strategy of power in the Roman house through an overview of these buildings, followed by an examination of a specific example, the House of Octavius Quartio in Pompeii.

Unlike the contemporary western home which is conceived of as a place of private refuge, the elite Roman house (the *domus*) consisted of both public and private space through which the *dominus* sent messages of power to his visitors. For this reason the *domus* has been aptly labeled a "powerhouse." However, despite extensive scholarly analysis of the rooms within the home, the role of one of the most important spaces in the *domus*, the garden, has been largely overlooked. It is generally assumed that the garden served no purpose beyond creating a peaceful green space within the home.

The purpose of this paper is to challenge this overly simplistic reading of the garden (Latin *hortus*) and to explore how the *dominus* might have used the garden space of his home, both its plants and its painted and sculptural program, to send messages of power through complex strategies of affirming and undermining the social positions and bodily integrity of his guests. Consequently, this paper will first briefly examine the background of natural landscape in literature and myth. It will then elucidate the rhetorical strategy of power in the Roman house, first through an overview of these buildings and then through an examination

of a specific example, the House of Octavius Quartio in Pompeii.

I. The Natural Landscape in Myth and Literature

The natural landscape which the *dominus* brought indoors in the form of a central garden space was imbued with literary and mythological tradition. A careful reading of myth reveals that the natural landscape was charged with the memory of rapes, kidnappings and dismemberments and that the plants themselves, many of which were formed (according to myth) as a result of rapes or violent transformations, also triggered these associations in the Greek and Roman mind. Moreover, in ancient Greece the natural landscape was often a metaphor for the female body. Anne Carson notes that while "[women are] united by a vital liquidity with the elemental world...Man holds himself fiercely and thoughtfully apart from the world of plants animals and female wantonness."¹ Carson also claims that since flowers were associated with virginity, the picking of flowers by a female mythological character foreshadows her impending rape and "defloration."

While Carson stresses the association of wild landscape with the female body, the French structuralists Marcel Detienne and Pierre Vidal-Naquet discuss Greek landscape in myth and ritual as the setting for gender ambivalence and reversal. Detienne claims that since the woman or wife is absent from natural landscape of forests and mountains, sociopolitical values are also missing and transgressions come to pass. Additionally, gender-inverting adolescent rituals were often carried out in the wilderness outside of the Greek *polis*. Adolescent boys were initiated into warrior life by temporarily masquerading as girls, thus behaving in a way which would be unacceptable in "normal" life. Young girls underwent gender inversion outside the city by dressing up as males before they were married. Girls who dressed up as bears at the sanctuary of Artemis at Brauron also underwent a period of ritual wildness from which they would turn when they were married.

The association of the inversion of gender roles with a natural landscape is apparent in myth as well as ritual. In Book 10 of the *Odyssey*, Odysseus and his crew arrive at Aea, the home of Circe. When Odysseus leaves his ship to explore the island, hoping to find plowed fields, he instead finds the house of Circe with "[smoke] curling up high through the

¹ Carson, Anne. "Putting Her in Her Place: Women Dirt, and Desire." *Beyond Sexuality*. Ed. Halperin, Winkler, and Zeitin. (New Jersey: Princeton University Press, 1990), 43.

thick brush and woods."² This is a setting much like that of the land of the Cyclopes in Book 9 of the *Odyssey*, a landscape which produces anxiety because it is untamed and devoid of human influence. The men decide to travel through the woods to Circe's house where they are drugged and turned into pigs. In this instance the bodies of the men are rendered ineffective and traditional gender roles are reversed.

Like Greek men in the archaic and classical periods, Roman males were also concerned with gender roles and attempted to protect their bodily boundaries, a concern reflected in Roman literature in general and Ovid's *Metamorphoses* in particular. The fifteen books of the *Metamorphoses* contain numerous instances of violent assault in a beautiful landscape setting (*locus amoenus*), and their influence on Roman wall painting has been demonstrated. In *Reading Ovid's Rapes* Amy Richlin observes that, while it was appropriate for a male to express love for a female or young boy, attraction between two adult males was unacceptable since penetration was seen as a staining of the body.³ It is easy to understand, given this penetration model with its active male and passive "female" figure, why Ovid's scenes of male rape would be so disturbing to the elite Roman reader. The active male/passive female assessment of Roman sexuality is indebted to the French philosopher Foucault and summarized by Jonathan Walters, who claims that the elite Roman male considered it his right to protect his body from violent and sexual assault.⁴ However, as Richlin notes, Romans expected gender inversion in literature, drama, and art, and at times, seem to have identified with the passive position of females or adolescent boys.

With this in mind, the myths of Ovid's *Metamorphoses* can be split into three typologies for the purpose of analysis. In the first a female figure is raped or penetrated. Here we find the story of Philomela who, while visiting her sister Procne, is raped by her brother-in-law Tereus in a hut in the woods (*Meta.* 6:590-977). The second typology consists of scenes in which the boundary of the male body is violated or the manhood and control of the main character is called into question. The story of Acteon and Diana belongs in this typology (*Meta.* 3: 155-252). Acteon is hunting in the woods when he stumbles upon Diana bathing in her grotto. As punishment for seeing her naked, Diana turns him into a stag and he is torn to pieces by his hunting dogs. The third typology is less connected with ideas of gender. Instead, nature itself proves to be dangerous because of its "wildness" and separation from the city. For example, when the lovers

Pyramus and Thisbe attempt to meet outside the city, a misunderstanding causes them both to commit suicide (*Meta.* 4: 55-166). Additionally, the story of Dryope speaks to the inherent danger of plants since she is turned into a lotus tree as punishment for picking lotus flowers (*Meta.* 9: 340-393).

II. Overview of the Roman House

It is interesting that many of these literary myths find their way into the Roman house (Latin *domus*) in the form of wall paintings. As the place from which the homeowner conducted his business and received his clients and guests, the *domus* has been aptly labeled a "powerhouse". Rooms dedicated to *negotium* (work) were located at the front of the house. These include the *fauces* (entryway) the *atrium* where clients waited to meet with the *dominus* (homeowner), and the *tablinum*, a room which separated the public *negotium*-centered part of the house from the private spaces further within the home. In the *tablinum* the *dominus* met with his clients and controlled the boundary between the public and private spheres of his home and was "set off as a static presence on stage, not unlike the image of a god in his sanctuary."⁵

The more private part of the house was reserved for *otium* or leisure and included dining rooms (*triclinia*) and bedrooms (*cubicula*) often arranged around a rectangular peristyle garden. The mythological fresco painting which often filled and surrounded these rooms could also be used to send messages of power. Notably, frescoes of mythological scenes were often reserved for the more private parts of the house to be viewed by guests of high enough status and learning to appreciate the culture of their host.⁶

Regularly, these painted mythological scenes included themes of violence and "gender bending" in the *locus amoenus* (the idyllic landscape). When these types of images were arranged around the garden of a *domus*, it is likely that the educated guest was able to make connections between the disruption of the *locus amoenus* in myth and the beautiful natural landscape in which he was actually standing. Additionally, anxiety might be induced by the guest's awareness of the dangers to his body which are associated with the natural landscape as a result of the stories of myth and literature. It is also important to note that Romans saw symbolism where we might only recognize beauty and functionality. As Barbara Kellum has observed, Augustus was able to send messages about his power and the fecundity of his rule through the painted garden imagery of Garden Room at the Villa of Livia.⁷

² Homer. *Odyssey*. Trans. Stanley Lombardo. (Indiana: Hackett Publishing Co., 2000). (10:165-167)

³ Richlin, Amy. "Reading Ovid's Rapes". *Pornography and Representation in Greece and Rome*. Ed. Richlin. (New York: Oxford University Press, 1992). 174.

⁴ Walters, Johnathan. "Invading the Roman Body: Manliness and Impenetrability in Roman Thought." *Roman Sexualities*. Ed. Hallett and Skinner. (New Jersey: Princeton University Press, 1997), 36.

⁵ Clarke, John R. *The Houses of Roman Italy 100 B.C.-A.D. 250*. (LA: University of California Press, 1991), 4.

⁶ Fredrick, David. "Beyond the Atrium to Ariadne: Exotic Painting and Visual Pleasure in the Roman House." *Classical Antiquity*. (University of California Press. Vol. 12, No. 2, October 1995), 267.

⁷ Kellum, Barbara. "The Construction of Landscape in Augustan Rome: The Garden Room at the Villa ad Gallinas." *The Art Bulletin*. Vol.76, 1994.

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Through decorative imagery and the plants themselves the *dominus* was able to create a space of anxiety and power; a reminder of the dangers of the *locus amoenus* represented by his garden. Moreover, by choosing his myths carefully in sculpture and painting, he could underscore the unsettling implications of the natural landscape found in Greek and Roman literature, myth, and ritual.

III: The House of Octavius Quartio

The many houses which have been preserved by volcanic ash at Pompeii are invaluable sources of information about the character of the elite Roman *domus*. In this section we will analyze the decoration, waterworks and statuary of the garden and rooms of House of Octavius Quartio and assess how these were used to send messages of power to its guests. An analysis of the way in which Octavius Quartio used water and myth in his garden space suggests that he was attempting to "cue" certain responses in his guests as he both affirmed and questioned their role in the social hierarchy.

Pompeii is an extremely large site and for this reason archaeologists have split the city into nine regions in order to more easily locate specific buildings (Figure 1). For example, region VII contains the forum and the public buildings associated with this space. Region VIII contains the theaters, and region VI contains many of the most expensive houses.⁸ The house of Octavius Quartio, though relatively small, is an excellent example of a home with numerous wall paintings and a complicated garden. Located in region II (II, 2,2) (Figure 2), its owner was originally considered to be Loreius Tibertinus until a bronze seal bearing the name of Octavius Quartio was found within the home (ca. 1950). This has led scholars to believe that he was the last owner.⁹ Little is known about Octavius Quartio himself, but his home has been well preserved and offers valuable information about the type of spaces that the Roman *dominus* attempted to create within his home. In particular, the garden could be used to extend the unsettling message of the beautiful landscape as found in wall paintings in the house.

The fourth style wall decorations which fill the house are the result of the remodeling which took place after the earthquake in 62 CE. The house is certainly noteworthy for these frescoes, but its most remarkable characteristic is the elaborate 1,800 square meter garden plot which extends from the back of the house to the

edge of the southern block. Unlike many typical Roman house gardens, the garden of the house of Octavius Quartio is not a peristyle garden. Instead, the garden contains an elaborate system of canals for the movement of water throughout the large outdoor space.¹⁰

The plan of this house is also unique. A narrow *fauces*

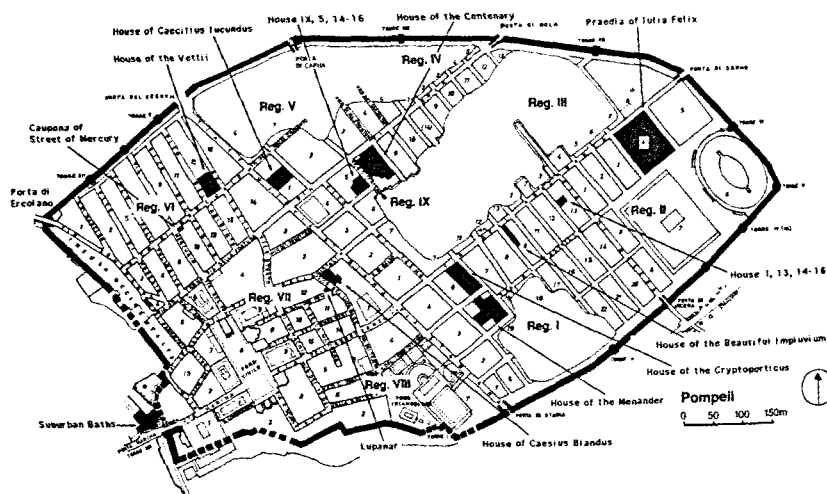


Figure 1. Map of Pompeii. From John R. Clark *The Houses of Roman Italy, 100 B.C.–250 A.D.*

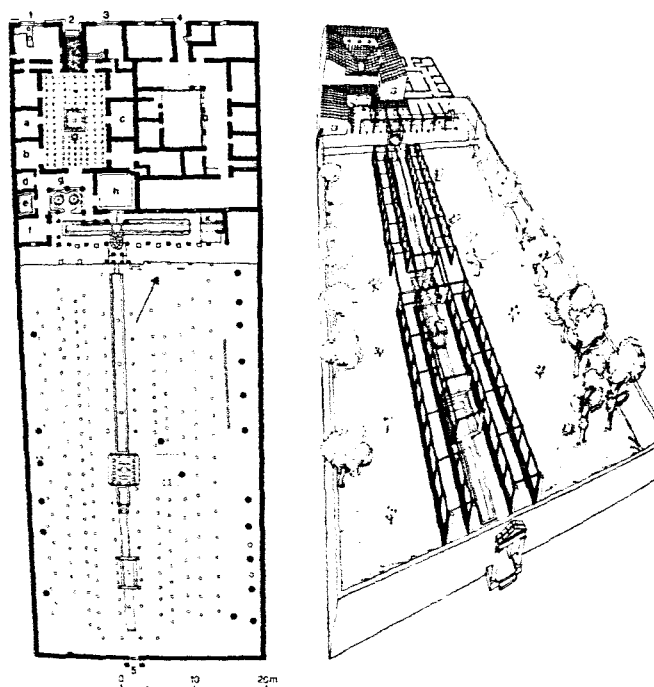


Figure 2. Plan and decoration of the House of Octavius Quartio. From John R. Clark *The Houses of Roman Italy, 100 B.C.–250 A.D.*

⁸ Zanker, Paul. *Pompeii: Public and Private Life*. Trans. D.L. Schneider. (Cambridge: Harvard University Press, 1998), 33.

⁹ Clarke. *The Houses of Roman Italy 100 B.C.–A.D. 250*. 1991, 193-194.

¹⁰ *Ibid.*, 194.

leads into a large atrium with an *impluvium* in the center. The house is axial so that the atrium offers a view into the garden space that dominates the back portion of the house. In most Roman houses the atrium and garden were separated by the *tablinum*, but here the *tablinum* has been omitted from the plan. Instead, from the atrium, a guest would move into a sort of small preliminary garden space *g* which is flanked by rooms *d*, *e* and *f* on the west and *h*, a large dining *oecus*, on the east. Room *f* affords a view eastward down a long east/west canal to room *k*, generally considered to have been a summer *biclinium* with two couches flanking a fountain. This east/west canal was the water source for the north/south canal which runs perpendicular to it and which carries water to the southern edge of the garden.

When one visits the house of Octavius Quartio in Pompeii, it is apparent that the garden is not only the largest space in the house, it is also larger than the sum of the interior spaces. Undoubtedly, the garden is the focal point of this home. Dining rooms *f* and *h* are situated in order to offer views into this large garden space. Likewise rooms *f* and *k* overlook the canal which creates a sort of elaborate porch, a transitional space into the garden. What, then, is the garden's function?

Bettina Bergmann describes the way in which Roman villas controlled views of nature in their interiors. She writes, "The ordered access to nature which is contained within the geometry of architecture, determined the appearance of actual and painted landscape in the Roman *domus*."¹¹ Villa owners captured landscapes by depicting them on their walls as "time-paused" for their viewing pleasure. They also attempted to control views of nature through windows and to confuse the line between real and painted landscape. "The interpretation of outside and inside and the shifting focus between art and nature continued to be a blurred, hallucinatory experience in which vista and vision are confused."¹² In this way, the elite owner created an unstable experience for his guests through the combination of man-made and natural structures. Art and nature were also combined in the gardens of the Roman *domus*. Geometric garden beds, statuary and other man-made structures asserted the *dominus*' power over nature. This would have been noted by his guests and served as a reminder of the *dominus*' power over his home and those under him in the social pyramid.

Ann Kuttner notes another example of the attempt to control nature in her article "Delight and Danger in the Roman Water Garden: Sperlonga and Tivoli." She writes,

The Romans understood that taming water was a nation-making enterprise, as when they praised the Cloaca Maxima, the great sewer drain, which salvaged the city's heart from the fetid marshland of the original settlement from the earliest days of the Republic. The control and transport of water produced quintessentially beneficial technological wonders to which Republican nobles and emperors proudly gave their names as society's life-bringers.¹³

Aqueducts legitimized the power of the republican aristocrats, and later, the emperors who built them. In an elaborate system of waterworks such as that found in the House of Octavius Quartio, it seems clear that the *dominus* is aligning himself with that message of sustaining dominance and perhaps with Jupiter himself, the god of the sky, who

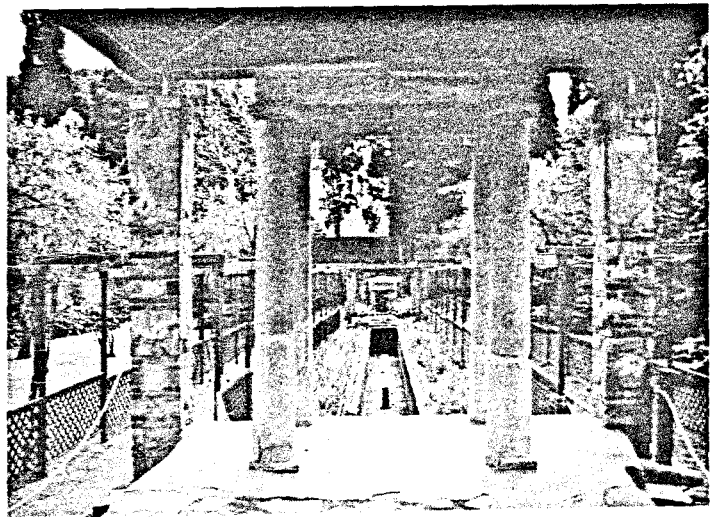


Figure 3. The canal running north-south. Personal Photograph

controls clouds and rain. The elaborate system of canals and architectural structures in the garden of the House of Octavius Quartio are a fine example of the owner's attempt to assert his dominance over nature (Figure 3). Not only has he brought order to the space through man-made structures, he has also shown his ability to harness water to sustain his family and his garden.

However, water carries other connotations. Kuttner observes that, "motion in water is neither simple nor safe"¹⁴ and she discusses the difficulty of moving in it, including the extreme danger of boat travel during antiquity and the fear of the open sea. Kuttner notes,

National or personal tribulation was imagined as

¹¹ Bergman, Bettina. "Painted Perspectives of a Villa Visit: Landscape as Status Metaphor." *Roman Art in the Private Sphere*. Ed. Gazda. (Michigan: University of Michigan Press, 1991), 61.

¹² *Ibid.*, 63

¹³ Kuttner, Anne. "Delight and Danger in the Roman Water Garden: Sperlonga and Tivoli." *Landscape Design and the Experience of Motion*. Ed. Conan. (Washington D.C.: Dumbarton Oaks, 2003), 105.

¹⁴ *Ibid.*, 107

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the struggle to guide a boat's journey, and social violence was a storm raised or calmed by destructive or benevolent leaders...From the archaic Hesiod important Greco-Roman authors represent water motion as driven by greed...Hellenistic kings and elite Romans made boating a pleasure sport and constructed floating islands from luxurious yachts. Yet moralizing Roman satirists and historians depicted such tastes as indicators of dangerous instability or fluidity of character.¹⁵

Thus, in one sense, water could be associated with danger and difficulty. For this reason we might suggest that its inclusion in the garden may also have been intended to disarm or unsettle the guest as well as highlight the power of the *dominus*. Water is not simple. Instead water carries complex, almost contradictory meanings, which are certainly part of the danger of the *locus amoenus* in literature. If water can be read with such complexity, then it is likely that, when included in gardens, water imbues the space with ambiguity.

It is also worth mentioning that another key Roman social ritual, bathing, which was associated with water and almost always preceded dining, was charged with a similar ambiguity. Roman baths were complex spaces and bathing itself was a two-sided and vulnerable action. Katherine M. Dunbabin describes these complexities in her article "Baiaurum Grata Voluptas: Pleasures and Dangers of the Baths." She notes that the mosaics, marble and reflected light of the baths created a space of beauty and pleasure. Men and women spent much time in their private baths receiving, entertaining, and impressing guests.¹⁶ However, Dunbabin additionally claims, "There could also be a darker side to the world of beauty and pleasure which the baths create. Excessive beauty, like any other exceptional achievement risks provoking *phthonos*, the envy which works through the Evil Eye of the envious, with disastrous consequences. Such dangers could threaten every sort of human activity...There is evidence enough to suggest that baths and bathers were especially vulnerable."¹⁷ She also suggests that baths were intrinsically anxiety-producing, since drowning and accidents were a real danger, and since baths and damp places were thought to be the haunts of demons.¹⁸ Baths could be spaces of both beauty and danger, a complex paradox which also finds a similar expression in the *triclinium* and peristyle garden.

In addition to the system of waterworks, Octavius Quartio included a sculptural and decorative program which may offer insight into how he intended his garden to be experienced. Thorough analysis of the frescoes which

surround the garden space suggests that they underscore the danger of the *locus amoenus*, since almost all of them depict myths in which a horrific event takes place in a beautiful setting, not unlike the one in which his guests now find themselves.

On the exterior of room f, which faces the east/west canal, four frescoes are painted. Fresco A depicts the Calydonian boar hunt. This is a particularly violent boar hunt resulting in the death of one man and two dogs. Interestingly, gender roles are confused and an erotic element is included in the story as the boar is struck first by a woman, Atalanta. After the hunt a dispute erupts concerning the spoils, and Meleager kills his two uncles. As punishment for this action Meleager's mother kills both her son and herself. Thus, while this may seem to be a simple hunting scene to us, the Roman guest, familiar with the literary precedent, would have been able to read between the images to recall the horrific and erotically charged event which took place during this hunt in the wilderness. This hunting image is bordered on the bottom by a frieze of dolphins and hippocamps.

The eastern facing exterior wall of room f also contains frescoes which are associated with the natural landscape and with unhappy events which occur in beautiful outdoor settings. Fresco C depicts Diana kneeling naked in a setting of hills and trees. Most certainly this image is in a dialogue with the image of Acteon located next to it. These two images are separated by the door leading into room f, but are nevertheless close enough together to be viewed as a set. Acteon stands naked in the center amidst a rocky landscape with his arms raised as two dogs tear into his legs. These two images in tandem reference the myth of Acteon and Diana during which Acteon stumbles upon Diana bathing in a grotto. It is helpful to remember that not only is it dangerous to view this goddess bathing nude, but, as we have seen, water and bathing itself are intrinsically dangerous. As punishment for seeing her naked, Diana turns Acteon into a stag and he is then torn to pieces by his hunting dog, consistent with the "male rape" typology found in Ovid's *Metamorphoses*. It is interesting to note that guests to the house of Octavius Quartio were not entirely detached viewers of these paintings. Simply, Acteon was killed for looking at Diana naked. Any guest who looks at this fresco group is also seeing Diana naked and any guest who looks at this fresco group is also committing the same offense, admittedly with a painted image. In this way the image, and the myth it calls to mind, unsettles the guest who stands at the entrance to the home's elaborate garden.

The north wall of the porch containing the east/west

¹⁵ Ibid., 108. Since we have discussed the triclinium and dinner party, it is interesting to note the connection that was made between the Greek symposium and a ship. Francois Lissarrague discusses this claiming that guests stood for the ship's crew and that broken cups or uncontrollable drunkenness symbolized a shipwreck. See: Lissarrague, Francois. *The Aesthetics of the Greek Banquet: Images of Wine*

¹⁶ Dunbabin, Katherine M. "Baiaurum Grata Voluptas: Pleasures and Dangers of the Baths". (Proceedings of the British Society in Rome. 1989), 8.

¹⁷ Ibid., 33.

¹⁸ Ibid., 35-36.

canal has three frescoes. The door to room h is flanked by a fresco of Orpheus (E) on the west. An image of Venus Marina (Venus of the sea), referencing love and water is positioned next to the Orpheus fresco along with a *Paradeisos*, a scene of an ideal natural landscape, on the east. These frescoes are less explicit in their attempt to send an unsettling message to the viewer, but they do not contradict this theory. In fact Ovid's *Metamorphoses* connects Orpheus with the idea that violent events and dismemberments are "cued" by beautiful settings. At the beginning of Book 10 Orpheus has summoned Hymen to Thrace for his wedding to Eurydice. There are many bad omens for the couple and after the wedding takes place the bride is bitten and killed by a snake as she strolls through the grass.¹⁹ Meanwhile in Book 11, a mob of Thracian women (Maenads), seeing Orpheus from a hilltop, decide to tear him to pieces savagely and beat him with clods and branches because he has scorned them. Through this action Orpheus' elite male body is penetrated and violated. The remains of the Orpheus fresco at the House of Octavius Quartio are fragmentary so it is difficult to decipher what is actually depicted in the scene. Nevertheless, any image of Orpheus would likely have invoked, in the mind of the Roman viewer, the memory of his horrific death. The two other frescoes, though not directly images associated with unsettling



Figure 4. Narcissus. Personal Photograph



Figure 5. Pyramus and Thisbe. Personal Photograph

events, fit in well with the other fresco scenes set in a natural landscape and with the dangers of *eros* and water.

Two frescoes are located in *biclinium k* on either side of a sort of colonnaded temple front sheltering a statue of a river god. The fresco to the north of this shrine depicts Narcissus, who like Acteon comes from the city of Thebes, staring, partially nude, at his reflection in a pool (Figure 4). Half of the picture is taken up with an architectural structure. However visible to the left of this is a wooded area, suggesting that Narcissus is outdoors. This would be in keeping with the story told by Ovid during which Narcissus falls in love with his reflection in the water and wastes away admiring it. While this may not be a frightening event, it is certainly unhappy and it fits into the "male rape" typology which we discussed in the first section. The story is also another instance in which water is associated with the vulnerability of the body. Since Narcissus falls in love with his reflection in a pool of water, he loses the ability or desire to sustain and protect himself. Finally, the fact that it takes place in the wilderness ensures that the fresco fits in well with the painted program of landscape and the vulnerable body which we have analyzed so far.

On the right side of the shrine an image from the story of Pyramus and Thisbe is depicted (Figure 5). As already established, Pyramus and Thisbe were two young lovers who attempted to meet outside of the city. As a result of a

¹⁹ Ovid, *Metamorphoses*. Trans. Charles Martin. (New York: W.W. Norton & Co., 2004), 341.

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misunderstanding both lovers end up killing themselves in their natural meeting place and their blood stains the berries of the mulberry tree purple. In the image, Thisbe leans over the bleeding body of her lover in the act of stabbing herself in the chest. The two dying lovers are surrounded by a wild landscape. A lion, who had wiped its bloody mouth on Thisbe's cloak causing Pyramus to believe she had been eaten, is visible in the background above their heads. This image, in which the beautiful landscape becomes the setting for the death of two lovers, challenges the idyllic nature of the *Paradeisos* painting on the wall adjacent to it. It seems to be the case that while the two lovers were in the city they were safe. Once they leave the city and attempt to be outdoors, they are vulnerable. The result is a horrific scene. In this way the images of Pyramus and Thisbe and Narcissus are in keeping with those of Meleager, Diana, and Acteon in that they highlight the intrinsic dangers of nature and the ability of the idyllic landscape to become a stage for death and rape. These form the majority of the images surrounding the canal which marks the boundary between the indoor and outdoor space of the house.

The long canal which travels down the length of the garden also contains some intriguing sculptural imagery. The canal itself is on a lower level than that of the upper canal. Thus it was necessary for the guest to descend into the garden in order to view the *aedicule* (a small shrine) of Diana, the surrounding frescoes and the garden plants themselves. The descent into the garden marks an interesting transition on the part of the guest. In the upper canal the guest stands in a space that is both indoor and outdoor, and he or she is primarily a viewer of images. The viewer stands in front of the fresco and views the action taking place in the image from the outside of the scene, though as noted above he or she may be implicated in the action simply by viewing it, as in the paintings of Diana and Acteon. In one sense, this makes the guest relatively safe. He or she is an outsider looking in on the action taking place in a beautiful natural landscape. However, once the viewer has descended into the garden he or she is no longer a passive viewer. Instead the viewer has become part of the scene, a character moving through the stage of the natural landscape and therefore sharing a vulnerable position similar to the figures depicted in the scenes in the upper porch. Beatriz Colomina offers a modern example of how someone moving through a house becomes a part of a spectacle or the object of the gaze. She writes,

In the Moller house (Vienna, 1928) there is a raised sitting area off the living room with a sofa set against the window... Anyone who, ascending the stairs from the entrance... enters the living room, would take a few moments to recognize a person sitting in the couch.

Conversely, any intrusion would soon be detected by a person occupying this area, just as an actor entering the stage is immediately seen by a spectator in a theater box... Architecture is not simply a platform that accommodates the viewing subject. It is a viewing mechanism that produces the subject. It precedes and frames its occupant.²⁰

What is interesting in the garden of Octavius Quartio is that the story of Diana and Acteon dominates it thematically and is recreated within it. Our guest has already been reminded of the story of Acteon and Diana in the images in the upper porch. Now that he is in the garden, the guest has moved physically into that scene. First, Acteon was hunting in the woods when he stumbled upon Diana. Like Acteon, our guest finds himself in a space that has been planted to resemble a natural landscape. He is surrounded by trees and shrubs, flowers and vegetables.

Secondly, Ovid tells us that Diana was bathing in a grotto in the wilderness.

There is a grove of pine and cypress
known as Gargaphie, a hidden place
most sacred to the celibate Diana;
and deep in its recesses is a grotto
artlessly fabricated by the genius
of Nature, which, in imitating Art,
had shaped a natural organic arch
out of the living pumice and light tufa.
Before this little grotto, on the right,
a fountain burbles; its pellucid stream
widens to form a pool edged round with turf;
here the great goddess of the woods would come
to bathe her virgin limbs in its cool waters
when hunting wearied her.²¹

As the guest descends into the garden he faces the southern wall. If he were to walk in the garden and to turn and look north towards the house, he would find himself staring directly into a recreation of the grotto of Diana. The grotto is tucked away under a sort of roofed structure supported by two columns (Figure 6). This marks the point at which the water from the upper canals is channeled to flow down the lower canal. On the back wall of this structure is an arched niche cut out of the stone wall and next to it is another image of a nude Diana. Here, in keeping with myth, she stands with her bare back to the viewer surrounded by water and stone architecture. In case the reference has so far been lost on the guest, an image of Acteon is included on the opposite side of the grotto along with an image of a landscape. It is noteworthy that the

²⁰ Colomina, Beatriz. "The Split Wall: Domestic Voyeurism" *Sexuality and Space*. Ed. Colomina 1992. taken from http://www.uark.edu/campus-resources/bigiane/library/txt_colomina.html.

²¹ Ovid. *Metamorphoses*. 2004, 97.



Figure 6. The "grotto" is located on the bottom level at the Source of the N/S canal. Personal Photograph.

angle of the guest's view leads his or her eye directly to Diana. Unless the viewer turns his or her head significantly, the viewer will only see the image of Acteon so that a connection is first made between Diana and the guest. It seems then that Octavius Quartio has created a space in which his guest has become the Acteon figure. The guest has unwittingly stumbled upon the grotto of Diana and has glimpsed her naked body. According to the myth, the male figure is now in danger of bodily harm. The implications of this "glimpse" for the female viewer are an open question.

Thus, the entire garden space is charged with reminders of the dangers of the *locus amoenus* in the form of both frescoes and architectural elements. In the middle of his home Octavius Quartio has created a space that both captivates and unsettles his visitors. Most importantly it seems that the decorative elements are related to one another in both the types of images and the moods they were intended to evoke.

In this home, nearly every fresco can be categorized as one which depicts or references the dangers of outdoor space. If Octavius Quartio is trying to say something through these images then it is likely that they would relate to one another. For this reason Paul Zanker's following analysis of the house of Octavius Quartio is an oversimplification.

Zanker claims that the trend in the first century CE at Pompeii and Herculaneum was to model a smaller, middle-class town house after an elite villa. The result of this fashion, Zanker argues, is often an odd and unrelated mix of villa elements. To prove this theory Zanker discusses the house of Octavius Quartio, calling it a "miniature villa."²² Clarke notes Zanker's comments in his own analysis of the house and writes,

Zanker counts many built elements taken from villa architecture: the canal, or euripus, allusive to the Nile; the rear peristyle with oecus; the little temple or aedicule with images of Diana; and the bichlinium with fountain. Add the many small-scale statues along the upper canal evoking gods as diverse as Isis, Dionysus, and the Muses, plus five different painted cycles on the exterior walls, two painted friezes from different epic sagas in the oecus, allusions to Isis in the sacellum, and one has an excellent example of the kind of bad taste that Cicero had decried a hundred years before.²³

In Clarke's analysis, all of this decoration combines to produce what he calls a "crowded Disneyland."²⁴ Zanker himself concludes, "The owner, eager to imitate the lavish world of villas he so clearly admired, preferred quantity over quality." Certainly it is more difficult to find continuity among the statues which line the porch and extend into the garden itself. One could argue that the herms of Dionysus (Bacchus) remind the viewer of the story of Pentheus in Euripide's *Bacchae*, Theocritus' *Idyll* 26, and Book 3 of Ovid's *Metamorphoses*, in which Pentheus refused to honor Dionysus and was torn to pieces by the Bacchantes in a clearing in the woods. The statues of the lion devouring the antelope and the greyhound attacking a hare may serve as reminders of the deaths that occur in the wilderness. They may also serve as reminders of mythological rapes since these are often compared to pursuit by a predatory animal of its prey, as in Ovid's treatment of Philomela. The statue of baby Hercules strangling a snake may be a reversal of the danger of nature since here man conquers the wild animal in much the same way that geometric beds and architectural elements might tame the natural landscape or garden, thereby highlighting the power of the *dominus*.²⁶ The hermaphrodite in the garden may have reminded the viewer of the fountain of Salmacis and the

²² Zanker, Paul. *Pompeii: Public and Private Life*. Trans. D.L. Schneider. (Cambridge: Harvard University Press, 1998), 145-156.

²³ Clarke. *The Houses of Roman Italy 100 B.C.-A.D. 250*, 24.

²⁴ Ibid., 24.

²⁵ Zanker. *Pompeii: Public and Private Life*, 156.

²⁶ A similar interpretation of the painting of Hercules and the snakes in the House of the Vetti can be found in Fredrick 1995.

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creation of the first Hermaphrodite through a sort of "male rape" scene. However, not every statue fits into this trend nor does it need to. This paper does not intend to suggest that every aspect of the garden served as a reminder of a violent event directly or indirectly. Instead, even a suggestion of violence or anxiety in the garden space complicates the simple "peaceful" reading which has been found in the scholarship to date.

The *Iliad* and Hercules friezes of room h are very different from those in room f and those on the exterior walls. However, if the space of the domus attempts to both affirm and disarm its male guests, then we may consider that room h, most likely the primary *triclinium*, with its emphasis on male power, strength and impenetrability, was a necessary part of the affirmative message.²⁷ This stands in opposition to the unsettling images on the exterior walls and in the garden, creating a now familiar tension between imagery that affirms male dominance and imagery that subverts or challenges it.

As noted, the point here is not to find continuity in every decorative element in the House of Octavius Quartio. Certainly there are a variety of types of imagery, some of which may seem entirely unrelated. But to say that the home and garden is simply a "crowded Disneyland" denies the calculating mind of the *dominus* and the thematic role of the garden within the house at large. While he may have made references to villas and highlighted his wealth by the variety of his decorative program, this does not refute the fact that Octavius Quartio could have sent very pointed messages to his guests through this decorative program. Not only was the Roman eye trained to see political and social messages in art, but we have also noted that much of the space and its decoration is connected by a literary history which taught Romans to associate beautiful outdoor spaces with terrible events. This analysis suggests that the House of Octavius Quartio was much more than a museum of haphazardly chosen cultural references. Instead, the owner utilized imagery on the walls of his home, statuary, a grotto, and the natural elements of the garden space itself to disarm his guests and to assert his authority over his home and his power in the Roman social hierarchy.

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Mentor Comments

Ms. Brutesco has been enthusiastically supported in her thesis work by her advisor Dr. David Fredrick, who writes:

I am very pleased to recommend this condensed version of Sarah Brutesco's honors thesis, "The Unsettling Landscape: Landscape and Anxiety in the Garden of the House of Octavius Quartio" for publication in Inquiry. While Sarah is an outstanding student in other respects, this letter will address specifically the contribution of her research.

The past two decades have seen significant new research on the rhetoric of power in the Roman house. The work of Bettina Bergmann, John R. Clarke, Andrew Wallace-Hadrill, and Paul Zanker in particular has illuminated how the architectural layout and decoration (painting, sculpture, mosaic) of the domus

²⁷ The interior frescoes of room f and the small peristyle garden also seem unrelated. These seem to focus entirely on images and statuary that recall Egypt. Included are images of a priest of Isis and statues of Ibis, Bes, and a pharonic figure. It has been suggested that the canals might have a reference to the Nile.

delineate and reinforce distinctions of class and gender. However, while these scholars have paid close, nuanced attention to the interaction of space and decoration in significant rooms of the house (fauces, atrium, tablinum, triclinium), the garden has been largely overlooked. It has been viewed primarily as a source of light, air, and greenery with little connection to the visual rhetoric of the rest of the house.

Sarah addresses this blind spot in her thesis. She demonstrates first that the natural landscape (the *locus amoenus*, or "beautiful place") carries with it a set of troubling associations in Greco-Roman culture. It is frequently a setting for gender-bending rites of passage in ritual, and violent assault, rape, and metamorphosis in literature and myth. She then argues that Roman house owners engaged these associations when they laid out and decorated their gardens. While the owner demonstrated his mastery over nature through the careful planning of the garden and its framing by a series of views, he could also suggest the violent, gender-troubled connotations of the *locus amoenus* through his arrangement of plants, sculpture, and paintings in and around the garden space. Hence the rhetorical strategies of the garden are complex, seeming to both affirm and undermine the boundaries of status and gender. Sarah demonstrates that such complex strategies are in fact found in the painted decoration of Roman houses, and in Roman literature associated with Roman dining. Hence they are appropriate for the garden.

Sarah uses as her test case the House of Octavius Quartio in Pompeii, making a brilliant argument that this house owner first announces violent themes in a natural landscape through two-dimensional wall paintings (Narcissus, Pyramus and Thisbe, and especially Actaeon and Diana) and then brings them to life in three dimensions in his garden. Specifically, the visitor to this house sees, in the upper part of the house, a pair of paintings of Diana surprised at her bath by Actaeon (a hunter who is subsequently transformed into a deer and torn apart by his own

dogs). Then, upon descending a set of stairs into the garden, the visitor himself comes upon a "real" grotto of Diana, with another painting of the goddess, whom he has now surprised in "real" space, just like Actaeon. Sarah argues that this clearly planned and intentional strategy of drawing the viewer into the *locus amoenus* as a setting for gender instability and violent transformation is not atypical. It connects the garden with rhetorical strategies which are common in wall painting and mosaics, and thus makes the garden a central contributing space to the overall messages of power in the house.

Sarah's thesis is firmly grounded in Roman art and architectural history, and draws upon a wide range of methodological approaches, from structuralist analyses of Greek myth and ritual (Detienne and Vidal-Naquet) to psychoanalytically informed studies of domestic space (Colomina on the houses of Adolf Loos), to Foucault's penetration model of Roman sexuality. Because of its breadth, Sarah's argument demands this theoretical range, and her ability to adapt her sources appropriately and judiciously is very impressive. If I were to come across this article in a journal I would sit up and take notice, because rather than overlooking the peristyle garden as an obvious and transparent space, Sarah problematizes it. This allows us to see it in a new way, as a sophisticated, complex player in the decorative program of the Roman house.

NOTE: Sarah's thesis work was supported by a Student Undergraduate Research Fellowship (SURF) grant for 2006-2007. She has traveled twice to Pompeii, first during the University of Arkansas Classics and Humanities study tour of Italy in summer, 2006, and again as part of a scanning project in ancient Ostia via the University of Arkansas Center for Advanced Spatial Technology in March, 2007. She has spent many hours walking through and photographing Pompeian houses, including the House of Octavius Quartio. It's unlikely her argument could have developed so fruitfully without these opportunities for extended hand-on experience at the site.

WHAT IS AILING THE GERMAN ECONOMY? A CRITICAL ANALYSIS OF GERMAN SOCIAL MARKET ECONOMICS

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Abstract

This paper offers a narrative historical description of the German Social Market Economy, from its inception following World War II, up to the recent Agenda 2010 reforms enacted under the administration of Chancellor Gerhard Schröder. It is the purpose of this work to explore why the German Social Market System enjoyed such a high degree of success in its early years, and which flaws might be causing the chronic problems of low growth and high unemployment that have plagued Germany more recently. In particular, the paper argues that a high-cost and highly inflexible labor market resulting from Germany's system of autonomous collective wage bargaining may be stymieing business growth and scaring away foreign investment.

Introduction

The health of the German economy is a topic of special concern, not only for the people and politicians of Germany, but also for all of the member countries of the European Union. As the largest economy in Europe, Germany's economic strength has significant influence on the well-being of its neighbors. Since the mid-1970s, the German economy has suffered under struggling gross domestic product (GDP) growth rates, with persistently high unemployment figures. At the end of 2006, eight percent of German workers were unemployed, with unemployment rates in areas of the East as high as 20%. Since reunification, Germany's real GDP growth rate has averaged a meager 1.8% (OECD Statistics 2007). Economists and politicians alike point to the severe weakness of the eastern German economy as a major cause for the current situation. The cost of unification is estimated to have exceeded €1.5 trillion, and every year the German government pumps €70 to €80 billion into the region, costs which consume four percent of the GDP annually (Economist May 8, 2004). The high unemployment in the area has spurred many of the young and skilled workers of the East to migrate elsewhere, resulting in a dramatic aging of this population and a loss in creative force. Apart from the problem of the East, many experts point to an inflexible labor market as a major cause for high unemployment numbers and see heavy bureaucratic regulations imposed by the German government as stymieing new business growth. Furthermore, weaknesses such as high labor costs, poor worker flexibility, a heavy tax burden, and high energy costs are all cited as detractors which

are keeping foreign and domestic investors from setting up production facilities within Germany (Economist Aug. 20 2005).

In order to better understand the current problems facing Germany's economy, it is useful to consider the history of Germany's modern political and economic system. Following the defeat of Germany in 1945, the country was occupied by the victorious Allied forces. Torn apart by the emerging Cold War conflict, two states emerged from the ruins of the Third Reich: the German Democratic Republic (GDR) in the East, a communist regime with strong ties to the Soviet Union, and the Federal Republic of Germany (FRG) in the West with a liberal democratic constitution. Although both states quickly recovered from the devastation left by the Second World War, Western Germany stood out in the following decades as a *Wirtschaftswunder*, or "economic miracle," quickly becoming one of the strongest economies in Europe. This period of economic growth would continue all the way into the early 1970s. At the core of the new development strategy for West Germany was the swift introduction of the Social Market Economy, combined with substantial financial transfers under the Marshall Plan and a currency reform enacted in 1948. Fueled by a heightened world-wide demand for industrial goods brought on by the Korean War, the period of the German economic miracle was characterized by skyrocketing increases in industrial productivity, along with historically low unemployment rates. Between 1950 and 1960 industrial production in West Germany had risen to two-and-a-half times the level of 1950, GDP grew by two-thirds, and the unemployment rate fell from 10.3 percent to an astonishing 1.2 percent (Haselbach 158).

Beyond its immediate success, the Social Market Economic System gained both popularity and recognition from the population at large in Germany. The degree of importance this system holds in the minds of the German people is best understood in light of the circumstances under which this system emerged. At the end of Nazi rule in Germany, recognizing the scale and gravity of the atrocities committed under it, the German people could not deny that as a group they had made a terrible mistake. In effect, this largely destroyed any sense of national pride upon which Germans could base their national identity. All chances had been lost to formulate a positive identification with "Germanness" and Germany's recent history.

However, a society cannot function for very long without a positive sense of collective identity, and in the wake of the post-war destruction and hardship, it was the return of prosperity under the economic miracle which would fill this void in the mindset of the German people. The renewed economic vitality which emerged under the institution of the German Social Market Economy allowed Germans to take pride in their collective industry and economic strength. The success of the German economy under the Social Market System came to form the founding myth upon which Germans based their collective national identity.

In its popular conception, the German Social Market Economy meant a departure from both the regulated Nazi economy and the planned Soviet economy. This system sought to balance a basic capitalist free-trade orientation with a set of state-managed social safety nets. It is important to note that this popular conception was not identical with the meaning that Social Market Economy had for the group of economists who had invented the term. However, as distorted as the public understanding of the term might have been, the ideological success of the German Social Market Economy among the German people was just as important to the success of the newly-formed FRG as the actual implementation of the system.

In the years immediately following the Second World War, the economic outlook for the majority of Germans was exceptionally bleak. The successful restoration of bearable living conditions for the German people, even in the most optimistic of expectations, appeared to be many years away. Everyday life was characterized by misery, destruction, and hunger. The task of clearing the rubble from German cities alone was expected to take a generation's work. According to the idealized version of the narrative that would become the founding myth of modern Germany, it was during this most desperate hour that the political initiative and vision of Ludwig Erhard returned the war-torn society to a path of economic success. Through the currency reform of 1948 and his liberal program for a new economic policy, Erhard catalyzed a period of unprecedented growth and prosperity which would last into the 1970s. The Social Market Economic System as instituted by Erhard had saved the people of West Germany from hunger and despair and made them successful and thus respectable once again. In light of these extraordinary achievements, it becomes understandable why a German author recently declared the Social Market Economy to be "up to now, the most successful conception of economic policy in the history of mankind" (Haselbach 157).¹ As extreme as

this statement may sound, it is representative of a widely held belief within Germany.²

Considering the importance Germans placed on their economic system, it is easy to understand the great level of concern caused when that system began to falter. In 1966, Erhard himself had to resign his position as chancellor over a mild economic crisis. However, this event would pale in significance when compared with what was to come. The first major blow to the German economy came in 1975, following a dramatic upsurge in oil prices in the previous year. In 1975, West Germany's GDP fell to negative 1.4 percent growth (Ulman and Knut 22). Although GDP growth had recovered by the following year, it began a downward trend which led to another recession in the early 1980's. Throughout the following years leading up to reunification, West Germany continued to experience low growth rates, averaging only 1.9% GDP growth for the decade. Simultaneously in this period, unemployment in West Germany doubled, growing from 3.4% at the start of the decade to 6.8% by 1989.

During the time leading up to reunification in the German Democratic Republic, there was a growing sense of disenchantment with the communist eastern German government, and its planned economy. East Germans had suffered for years under a period of relative economic decline in the face of growing wealth and prosperity in the West. The Easterners were convinced that they had been kept from living up to their economic potential by the system which had been imposed on them following the Second World War. The foundational myth of the FRG was believed here as it was in West Germany. Many felt that once the constraints of the Soviet-style system of central planning were lifted, they too would experience the vigorous growth achieved by the West following the war. In short, many in the East predicted a second "economic miracle" to occur following reunification and the implementation of free markets under a liberal democratic government.

These views were widely held and propagated in the West as well. Following the fall of the Berlin wall, Chancellor Helmut Kohl helped win the election for his party's eastern subsidiaries by promising a currency reform in the summer of 1990, calling back the memory of the 1948 currency reform and its subsequent success. For the public, "currency reform" with the introduction of the economic and social laws of the West, i.e., the "social market economy," seemed to guarantee a repeat of the first miracle in the West. Chancellor Kohl proclaimed that the East would be transformed into a *blühende Landschaft* (blooming countryside) within a few years of

¹ This quotation, translated by Dieter Haselbach, was taken from Helmuth Seliger, "Alexander Rütow—ein Verteidiger des Mittelstandes," in *Perspektive 2000*, ed. Lothar Bossle (Würzburg: Creator Verlag, 1987), p. 116: "Die bislang erfolgreichste wirtschaftspolitische Konzeption in der Geschichte der Menschheit (ist) [...] unstreitig die von Ludwig Erhard in die Wirklichkeit umgesetzte Soziale Marktwirtschaft."

² To give one more example: In 1977, the prominent political writer Rüdiger Altmann stated that "Social Market Economy" was "die erfolgversprechendste Wirtschaftspolitik des Kontinents" (the most promising economic policy of the continent"). *Wirtschaftspolitik und Staatskunst. Wirkung Ludwig Erhards. Aus Anlaß seines achtzigsten Geburtstags* (Bonn: Ludwig Erhardt-Stiftung, 1977), p. 5.

social and monetary union with the West. At this time, Ludwig Erhard's book from 1957, *Wohlstand für alle* (Prosperity for All), appeared newly in print and was distributed freely in East German streets. It was a widely held belief among the German people, both eastern and western, looking back on the German *Wirtschaftswunder* of the 1950s, that history was about to repeat itself (Haselbach 177).

However, the problems of stagnant GDP growth and rising unemployment, which had surfaced in the FRG in the 1980s, were only intensified following German unification. Since reunification in 1990, Germany has seen annual average real growth of only 1.8% and unemployment rates have averaged 7.5% over the same period (OECD Statistics 2007). Before unification, West Germany had maintained a great degree of social stability by alleviating social friction through the redistribution of wealth. The resulting welfare state with its generous unemployment benefits, universal health care, comprehensive social security, and indexed pensions was in turn dependent on a certain level of economic growth to finance existing programs (Witt 368). The expansion of social programs and entitlements to East Germany added pressure to the already strained social budgets while straining relations between East and West Germans. West Germans had to pay more into the social budgets during a time when benefits were being rolled back. And in the new federal states, the application of West German social legislation contrasted unfavorably with the much more comprehensive welfare system that had previously existed in the GDR (Haselbach 175).

Many problems now face Germany as it seeks to lower its unemployment, attract foreign investment, and return growth rates to acceptably high levels. In this paper, some of these important problems that Germany is currently facing are explored. Section I will focus on the differences between the mythos of the German Social Market Economy and the actual preconditions and policy actions which spurred the *Wirtschaftswunder* of the 1950s. Using this information as a basis, I intend to shed some light on why the second "economic miracle" never occurred. Section II addresses one of Germany's most pressing problems today, facing its very expensive and highly inflexible labor market. It will be suggested that the current system of autonomous collective wage bargaining is hindering Germany's growth potential and thus explains Germany's trouble reforming this system. In Section III, German economic reform strategy enacted in 2005, known as the "Agenda 2010," will be described, including consideration of some of the specific goals set out in this agenda and the progress that has been made in Germany in response to these measures. The paper concludes with an outlook on the upcoming challenges facing Germany as it adapts to a post-industrially structured society in the modern era of global capitalism.

Section I: The myth versus the reality behind the German Economic Miracle

In the years directly following the Second World War, the main task facing western policy-makers was to ensure the basic living conditions of the population while building up a new state and economy. Socialist and communist politicians argued for a central distribution system, extensive state controls, and the nationalization of banks and industry. Leading their opposition, in favor of a liberal or capitalist system, were two economist-politicians considered the fathers of the Social Market Economy: Ludwig Erhard, who had been appointed Minister of Economics in the first cabinet of Konrad Adenauer and who would later serve as German Chancellor, and Andreas Müller-Armack, permanent secretary in the Ministry of Trade and Commerce. These two figures held between them the most powerful positions in determining Germany's economic policy (Rösch 1-2).

The task of restoring West Germany to a path of economic success at this time must have seemed very daunting, both to the German people and to politicians like Erhard and Adenauer. Following the Second World War, daily life for Germans was characterized by the death and destruction left behind by the war, shortages of food and decent housing, and a growing national shame as the scope and scale of Nazi atrocities came more fully to light. And yet, very soon after these darkest of days, the West German economy was booming, unemployment was virtually nonexistent, and the German people could once again take pride in their collective industry and economic success as growth and productivity rates soared. The 1950s mark the decade of the German Economic Miracle, a miracle which many felt had come about thanks to the return of free markets under the Social Market Economy.

As successful as the Social Market Economy may have been in the time directly following its inception, its disappointing performance in recent years has called into question how much of the early success was due to the system itself, and how much had been caused by other factors. From the early 1970s until very recently, economic growth in Germany remained stagnant and unemployment rates hovered persistently between six and nine percent (See Appendix 1). Furthermore, during German reunification in the early 1990s, a time when German politicians and people alike predicted a second economic miracle following the introduction of western liberal markets in the East, the economic woes of West Germany were only compounded as it struggled to modernize the severely outdated Eastern industrial base. Eastern Germans, rather than experiencing unprecedented growth and prosperity, as had occurred years earlier in the West, suffered under growing unemployment rates that skyrocketed to as high as twenty percent in many areas (Ulman 14).

Questions concerning these developments in

Germany over the last decades abound: What were the factors that catalyzed the Economic Miracle of the 1950s in West Germany? Why could this success not be duplicated years later in the East? And most importantly, how might united Germany change its system to restore growth and unemployment rates to acceptable levels?

To answer such questions, one must first consider the factors stimulating the success of the 1948 currency reform. After the collapse of Germany in 1945, the German economy rapidly deteriorated into a barter economy. During this period, German money was rendered virtually useless, serving neither as a means of payment nor as a store of value. Individuals and firms were forced to acquire most of the commodities they needed by exchange against commodities they had to offer. Often it was more profitable for employees to skip work for part of the week so that they could cultivate private gardens, or barter for commodities on the black market. By the middle of 1948 the economy had reached a state of paralysis resulting in near-starvation for a large part of the population (Lutz 122). It was against this backdrop that the currency reform of 1948 was enacted.

One of the key reasons why the miracle of economic recovery in Germany became so convincing was the claim that West Germany was starting from scratch at the time of the currency reform. On the 20th of June in 1948, the day of the currency reform, each West German citizen received forty *Deutsche Marks*, the new money to replace the inflation-stricken *Reichsmark* (Haselbach 161). Referring to the Social Market mythos, this was the first day in Germany when free markets were able to work their magic. In the course of this day, the black market suddenly disappeared in correspondence with the return of the supply of food and commodities. Shop windows that had been empty the day prior were now adorned with a new abundance of much-needed merchandise. Following years of want and starvation, this day did seem like a miracle to the millions of Germans who lived through it.

Although the astounding change accomplished on the day of the currency reform did much to restore the confidence and optimism of the German people, calling it a miracle ignores many of the key elements that contributed to its fruition. The currency reform did not kick off recovery. Rather, it was one carefully staged step in the process of returning Germany to the path of economic growth (Haselbach 162).

One of the most significant factors contributing to Germany's successful economic recovery following the war was the presence of a modern and relatively intact industrial base. Under National Socialism, particularly during the war, Germany's economy had been very successful for two main reasons. For one, through their military acquisitions during

the war, the Nazis had access to an abundant supply of labor in the occupied territories and were able to exploit a wealth of raw materials to which they had gained access. Also, the system of economic planning under the Nazis had been quite successful. The Nazis succeeded in combining the resources at their disposal with the initiative of the German economy that they had inherited. Although the destruction resulting from Allied bombardments in the final weeks of the war had been devastating to both the housing and the transportation infrastructures, much of the industry proper was left relatively untouched. All in all, due to Nazi successes, Germany's postwar economy inherited a highly modern industrial stock.³ To a great extent, it was this inherited industrial base that set the stage for the subsequent successes experienced under the Social Market System (Haselbach 163).

The immediate and visible success of the currency reform in 1948 can be attributed to other factors preceding that landmark day. As early as 1947, the economy had already turned a corner toward recovery thanks to a carefully crafted policy of central allocation of scarce resources. The introduction of the new currency would not have been effective without the preexisting recovering economy to back it (Ibid 164).

The sudden appearance of commodities in shop windows on the day of the reform can be understood in light of the manner in which the reform was introduced. German politicians had openly announced the coming of a major day of economic reckoning months before the reform itself. This information had sent wholesalers and producers a clear signal to hoard commodities. Knowing that the reform was imminent, traders did not want to sell against the dying *Reichsmark*, waiting instead to exchange their goods for the newly established *Deutschmark* (DM). In the month preceding the reform, the supply of goods in retail shops had dried up almost completely, only to be newly replenished with the introduction of the new currency (Lutz 132).

Along with initiating the return of commodities to German shops, the currency reform marked the beginning of substantial increases in productivity and output in the German economy. Before the close of the year in 1948, industrial production had already risen by an astounding 53 percent (Ibid 133). This rapid growth was set off by a number of significant factors. Prior to the currency reform, part of production undoubtedly went into hidden stocks, or was used for bartering purposes, and was not reported. Thus output figures preceding the reform most likely underrepresented actual output. Also, the introduction of the new currency significantly lowered the rate of absenteeism in the work place. Following the currency reform, the rate of absenteeism dropped from 9.5 hours a week in May to only 4.2 hours by October. The new currency

³ In contrast to the West, where occupying Allied forces left much of the German industrial as it stood at the end of the war, following the war, much of eastern Germany's industrial stock was disassembled and carried off by the Russians.

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had made it once again worthwhile to work for money, rather than spend time foraging and bartering. Moreover, with the return of a functioning currency came a drop in the real costs associated with executing business transactions. Time formerly spent arranging complicated barter agreements could finally be used toward more productive ends (Ibid 133).

The visible effects of the reform evident in shop windows, combined with substantial increases in output productivity and quality of life, helped to convince the public at large that the new currency was reliable. This, in turn, boosted consumer confidence, further aiding the progress of economic recovery. Economic growth in Germany was additionally aided by an increased world demand for manufactured goods, stimulated by the Korean War. For much of this period, German exports also enjoyed a competitive advantage in international markets because the German currency was undervalued, making German goods cheaper in foreign markets (Haselbach 163-166).

Given this extraordinary set of circumstances, Germany was well positioned for a boom as it entered the 1950s. This growth potential certainly could have been spoiled by ineffective economic policies, and much credit is due to both Erhard and the West German government at that time. However, crediting the theoretical formula of the Social Market Economy for the success enjoyed during this decade is wrong for two reasons: because it ignores the governing set of circumstances preceding the expansion, and because the policy actions of Ludwig Erhard were less driven by a coherent theory of economic practice than by an astonishing pragmatism (Ibid 164). Although the Social Market Economy might well be described as a variation of market liberalism, and under Erhard markets were indeed liberalized wherever economically feasible, he did not hesitate to resort to state control and planning in fields where it seemed appropriate to him, such as in housing, coal supply, or agriculture. Social market theory recommends the establishment of markets framed by institutional regulations, with these regulations standing as the only checks against the self-destructive tendencies in market economies. However, Erhard did not follow this form of governance, instead using state action in the market proper as a standard tool of his policy (Ibid 164).

These conditions surrounding the introduction of the Social Market Economy are important to remember when considering the disappointing outcome following the introduction of the West German currency in the East after reunification in the 1990s. Most notably, the currency reform of 1948 did not, in and of itself, catalyze recovery. Rather, it was merely a step amongst a large set of preexisting circumstances which, as an aggregate, produced the vigorous growth rates of the 1950s.

How different was the situation in eastern Germany in the time leading up to reunification! Virtually none of the factors contributing to West Germany's success in the 1950s were present in East Germany leading up to the 1990s. East Germany had suffered from a long period of relative economic decline in the face of the growing wealth in the West, which left it with an outdated industrial stock, as opposed to the modernized stock of West Germany following World War II. Rather than possessing an undervalued currency to boost competitiveness in international markets, East Germany was burdened, under the "currency reform," with the highly appreciated DM, making East German goods more expensive in foreign markets. The introduction of this new currency not only failed to help the eastern German economy, but it hurt the area and contributed to a sharp decline of economic activity. It was only the comparative strength of the West German economy and an enormous and ongoing transfer of wealth that kept East Germany's economy from a total breakdown, since it was fully exposed to the world market after currency reform (Haselbach 178).

The disappointing performance of East Germany following market liberalization and the introduction of a western currency illustrates the point that growth and economic success are not guaranteed by trade liberalization if other necessary preconditions are not also met. In the same way, it was not so much the Social Market Economy that was responsible for West Germany's success, but rather a combination of the aforementioned preconditions in combination with an appropriate economic policy.

Section II: The high cost of labor in Germany

When asked what could be causing the chronically high rates of unemployment experienced in Germany over the last several decades, political and economic experts alike point to a high-cost and highly inflexible labor market.⁴ Simply put, it has become too expensive for many firms to hire workers in Germany. Furthermore, once a firm has hired workers in the country, an extensive body of labor laws and restrictions regulates nearly every aspect associated with maintaining those workers, including making it very difficult for firms to lay them off (Economist, 2003). Over the years, these factors have forced firms in Germany to either reduce employment or move elsewhere, and have scared away a multitude of outside investment and employment opportunities.

The vast array of labor market problems in existence today may be attributed to the nature and development of industrial relations in Germany. The Social Market Economic system, which emerged from the post-war period under the guidance of Ludwig Erhard, is often described as a blending of ideas from liberal thought (most notably, stressing a basic free-trade orientation) with a set of social precepts that modify

⁴ The debate over Germany's attractiveness as a location for investment in production facilities is encapsulated by the phrase "Standort Deutschland" and can be found in a wide array of academic publications. For a good description of the issue see Harding (1999), Tüselmann (1995, 1998), and Zumwinkle (1995).

the outcome of the market process through redistributive measures for the sake of balance and social security. These social precepts indicative of the Social Market Economy were incorporated via a system of extensive social welfare, along with a system of autonomous collective wage bargaining (Witt 366).

This system of collective bargaining, which comprises the defining element of German industrial relations, won support in the aftermath of the Nazi era as a counterweight to the power of the state and large-scale industry in the operation of the Social Market Economy. While it was the responsibility of the government under this system to socialize risks and provide economic security to wage earners (i.e., to provide social welfare), this power was counterbalanced by the constitutionally guaranteed autonomy of trade unions and employer associations in the determination of wages under collective bargaining. The latter institution was intended to function as an instrument of social justice by establishing parity of bargaining power between workers and employers. It was also the intent of this system to help reduce income differentials and tensions between the two classes and avert industrial unrest (Koch 234-254). Although the system of collective wage bargaining has proved successful in many of these respects, this institution has also had a number of unfortunate consequences.

As a direct result of Germany's system of industrial relations, the cost of labor in Germany, represented by wages or salaries and non-wage benefits, has risen over the past thirty years to one of the highest levels in the world. West German workers cost on average €27.60 an hour, compared with €19.90 in Britain and €18.80 in America (Economist, Aug 2005). A large portion of these labor costs can be attributed to so-called "non-wage labor costs." According to the annual analysis by the Institut der Deutschen Wirtschaft, non-wage labor costs are defined as those categories of the enterprise's total labor costs other than direct compensation (Chen 2). From 1972 to 2000, the ratio of non-wage labor costs to direct compensation grew by 25.6 percentage points to 81.2%. This represents the highest level of non-wage labor costs in the Euro-zone (Institut der Deutschen Wirtschaft 2001, table 148).

Apart from expensive labor, corporations in Germany must shoulder a heavy tax burden and a set of highly inflexible market regulations. As of 2004, the basic level of corporate tax stood at 38.7%, the highest rate in Western Europe (Economist May 8 2004). Furthermore, labor regulations developed under the German system of industrial relations have made it extremely difficult for firms to fire workers once they are employed. For example, at the end of 2003, it took Software AG, a globally active firm based in Darmstadt, three months to lay off 200 of its employees. In the U.S., the same measure took the company only two weeks to complete. The fact that it was possible for Software AG to make these lay-offs at all was only due to the enactment of Agenda 2010 reforms earlier that

year, which loosened job protections enough to allow the lay-offs to occur (Economist May 8 2004). In the modern era of increasingly free trade and global capitalism, firms are gaining considerably more freedom to locate their production facilities in areas where factor costs are most efficient. The combination of high costs and inflexibility has both discouraged outside firms from investing in Germany and caused many of Germany's domestic firms to move their operations elsewhere, for instance to central European countries where labor costs average below €5 per hour (Economist, Aug. 20 2005).

At first glance, Germany's system of autonomous collective bargaining between employers' associations and trade unions may seem to be both an effective and efficient method for protecting worker interests. Indeed, the system has enjoyed great popularity and acclaim over the years of its existence, both within Germany and in other European countries where it has often been cited as an exemplarily stable and highly functional model for the regulation of working conditions. The principle of co-determination between management and employees, carried out on the company level in Germany through the works council (*Betriebsrat*), most notably in the 1960s, helped create a strong foundation within German companies by maintaining harmony between workers and employers (Economist May 8 2004). Further, because the whole process is self-regulated by the union and employer groups directly involved, it relieves the state of the burden of regulating and legitimating labor standards (Winter 183).

As numerous as arguments in favor of Germany's model of industrial relations may be, there remain manifold aspects of the system that are clearly problematic in both a theoretical and an empirical sense. Throughout the course of years of repeated wage negotiations, union representatives have succeeded in obtaining an income distribution significantly higher than the competitive outcome, and have shielded union workers through extensive labor laws to a great extent against layoffs and other job risks. Unit labor costs in Germany, which stood at 60 percent of the U.S. level in 1970, reached over 140 percent by 1990. In this same period, productivity growth in Germany was lower than in the U.S. (Ulman 12). While these accomplishments are certainly very beneficial to union members, their effects have proven devastating to firms that must compete on the global market. Furthermore, this method of socially correcting free markets gives rise to a rent-seeking dilemma that casts doubt on whether the implementation of such a method has anything to do with the pursuit of social goals at all.

In his paper titled "Germany's Social Market Economy: Between Social Ethos and Rent Seeking," Ulrich Witt of the Max Planck Institute for Research into Economic Systems outlines with great clarity the dilemma associated with Germany's system of collective, centralized wage bargaining. He begins with the concession that decisions in negotiations

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are indeed reached by mutual agreement between the labor and employer interests. He continues by qualifying that this agreement is made by the representatives of the associations and not by the individual parties bound by the wage contract. Witt argues that in this seemingly insignificant detail lies the system's greatest problem:

The majority opinion within the employer associations determines their judgment about the acceptability of an agreement. Experience suggests that this opinion is based on whether the resulting cost increases (direct wages and salaries plus non-wage labor costs) of different grades of labor can be recouped without loss of profitability in the industry. It is doubtful, however, whether the majority opinion, especially under the pressure of actual or potential strike, takes sufficient account of the variance in the profitability of all member firms. Because the member firms are not allowed to pay less than the union rate, firms at the lower end of the profitability distribution are forced to reduce employment or even to go out of business when wages and non-wage labor costs rise. This outcome occurs even where the employees of these firms are willing to work under conditions worse than those specified in the agreement. (Witt 372)

In other words, by requiring wage and benefit increases to be implemented across entire industries, many companies that under normal circumstances would be economically viable are no longer able to make profits, resulting in the need to lay off workers, move facilities elsewhere, or even terminate operations. Until very recently, despite the fact that the unemployment problem has been growing progressively worse since the mid-1970s, German labor unions have continued their strategy in negotiation rounds of seeking wage and benefit increases equal to the estimated average annual gain in labor productivity. Union representatives in practice do not have to admit responsibility for ill effects resulting from their contracts because, in the Social Market Economy, the individual unemployment risk is covered by state-managed social insurance and public assistance. To frame the problem in the economic terminology of costs and benefits, the benefits of an expansive wage policy are reaped privately by union members, while the costs are born collectively by German taxpayers (Witt 372-373).

Although the problems resulting from the highly expensive and inflexible German labor market have become increasingly obvious, efforts towards reforming the system of collective wage bargaining behind it have been held back for a number of reasons. First and foremost stands the country's federal power structure, spread over the 16 independent

Länder, which was deliberately designed after the Second World War to weaken the ability of a central government to impose radical reform. Numerous failed attempts to reform Germany's labor laws in recent years have proven this system to be all too effective (Economist May 8 2004). Furthermore, the Law on Collective Agreements (*Tarifvertragsgesetz*), which forms the legal basis for sectoral relations between employers and unions, was incorporated into the German Constitution (*Grundgesetz*) in 1949 and has remained largely unchanged ever since (Winter 189). Finally, the system of collective bargaining has operated in Germany for many years, retaining a high degree of popularity in the country. As a result, politicians frequently shy away from the issue of reforming Germany's cumbersome and expensive labor laws (Economist May 8 2004).

Although the system of collective wage bargaining in Germany certainly has resulted in healthy worker/ employer relations and a high degree of wage equality across employment sectors throughout Germany, the problems resulting from the system, such as high unemployment and an inflexible labor market, bring into question whether the system has helped Germany at all. In spite of the many arguments claiming that free competition will ultimately drive wages below the cost of living,⁵ one thing is clear: if the problem of unemployment in Germany is ever going to be solved, the country must move to deregulate its labor markets and lower the cost of employment to a more competitive level. Although such reforms might sacrifice a certain degree of pay equality, the benefits brought on by lower unemployment and higher economic growth would certainly result in an increased level of "*Wohlstand für alle*" (prosperity for all).

Section III: Agenda 2010

In 2005, former German Chancellor Gerhard Schröder spearheaded a series of reforms known as Agenda 2010. The purpose of this reform package was to modernize the German social system and labor market. The main aims of these reforms were to improve economic growth and thus reduce unemployment. The agenda focused on three areas: the economy, the system of social benefits, and Germany's position in the world market. Specific reform steps to be taken included reductions in health care benefits, restructuring labor regulations, tax cuts, and an overhaul of the pension system (*Deutsche Welle* Oct. 17 2003).

In a speech delivered on March 14, 2003 introducing the reforms, Schröder asserted that a massive effort from all sections of society would be needed to carry out these important reforms. Indeed, the span and magnitude of the Agenda 2010 reforms were unprecedented and touched on a wide range of government actions. Monthly premium

⁵ A popular form of this argument denotes competition via free markets and global capitalism as a "race to the bottom." Another argument, encapsulated by the phrase "low wage or no wage," focuses on the trade-off between greater pay equality and higher unemployment versus lower unemployment and greater pay inequality. For a good summary of this debate, see Brueckner, 2000.

payments for the national healthcare system were to be gradually reduced from 14.3% of an employee's income to 12.15% by 2006. The reduced premium was aimed at lowering Germany's staggering non-wage labor costs. To finance the cuts, certain non-vital health procedures would no longer be financed by the public health fund, and patients would be required to co-pay for doctor visits and prescriptions. Also, to introduce more flexibility into Germany's heavily regulated labor market, a reform was passed making it easier for companies to hire and fire employees (Eironline Mar. 31 2003).

The most controversial section of the reforms, known as Hartz IV, merged unemployment and welfare benefits. The Hartz IV reforms reduced to 12 months the time during which a person can receive maximum unemployment benefits following job-loss. In addition, long-term unemployment benefits, which formerly paid out as much as 57 percent of a person's last regular net income, were reduced to a capped level of 345 Euros per month. These benefits were further qualified, making those with a working spouse or assets exceeding 13,000 Euros ineligible for payments. Also included in this reform package was a tax cut changing the country's progressive tax rate from 19.9% to 15% at the lowest level and from 48.5% to 42% at the highest level. Other reforms included eliminating the requirement of a master craftsman's diplomas in 65 skilled trades before a worker is allowed to be self-employed, an increase in the age of pension eligibility from 65 to 67, along with a reduction of pension levels from 40.1% to 38% of a recipient's former income, and an increase in the percentage received by communities of local business tax from 2.2% to 3.6% (*Deutsche Welle* Oct. 17 2003).

The Agenda 2010 reforms have already helped the economy make a remarkable turnaround. In 2006, Germany's GDP was up by 2.7%, the highest increase since 2000. Productivity also rose by 2%, a remarkable improvement, considering productivity growth averaged only 0.7% between 1998 and 2004 (Investor Business Daily Apr. 9 2007). Germany's traditionally strong export sector has also been booming, with exports increasing by 12.5% in 2006. A recent survey from Ifo., a Munich economics-research institute, shows business confidence to have reached a 15-year high. This recent succession of improvements serves as an indication that Germany is well into the upward curve of a typical eight-to-nine year investment cycle (Economist Jan. 5 2007).

Two years ago such a turnaround seemed hardly possible. In March of 2005, unemployment peaked at 12.1%. This alarming rate of unemployment helped convince German unions to agree to longer hours and even wage cuts in some cases. Such concessions in combination with recent reforms have allowed German corporations to make considerable improvements in cost competitiveness. Since the end of 2001, unit labor costs have fallen by 13.4%, compared to a

7.7% increase in the U.S. (Investor Business Daily Apr. 9 2007). Real wages per employee since 2000 have increased a modest 6%. This recent practice of wage moderation has given German companies a comparative advantage over rivals in France, Italy and Spain where, in the same period, wages increased by 12%, 18%, and 27% respectively (Economist Jan. 5 2007).

To a great extent, this recovery has been driven by the recent successes of Germany's large corporations. Over the past two years, they have been making significant structural adjustments, cutting costs vigorously, investing abroad and holding down wages. Recent government reforms have also helped companies regain their competitive edge, by introducing more labor flexibility and lowering corporate taxes from 38.6% to 29.8% (Investor Business Daily Apr. 9 2007). As a result, corporate profits in Germany are healthy and the DAX, a stock index for Germany's top 30 companies, climbed nearly 30% in 2006 to its highest levels since 2000 (Ibid).

Although the economic situation in Germany has improved considerably over the last year, the outlook for the next several years is not entirely rosy. Doubts remain about the durability of this recent German revival. The German Achilles' heel of low consumer spending has failed to make significant improvements in recent years. Although domestic consumption has picked up, improvements have been largely confined to the areas of transport, communications, leisure and entertainment, with consumers still holding back when it comes to spending on food, holidays at home, and clothing (Economist Jan. 5 2007). Third quarter data from 2006 shows expenditures as being up by only 0.8% since 2003, when expenditures decreased by 0.5% (Warton Mar. 28 2007). This would indicate that recent GDP improvements have been largely sustained by German exports, leaving Germany susceptible to a downturn in the global economy. Furthermore, the strengthening euro in relation to the weakening dollar will undoubtedly put increased pressure on Germany's export sector in the coming years (Ibid).

Outlook: The Need for Further Reform

In a speech given to a conference by the Federation of German Industries (BDI) and the Confederation of German Employers' Associations (BDA) on October 16, 2006, Joaquin Almunia, the European Commissioner for Economic and Monetary Policy, evaluated the progress of the Agenda 2010 reforms and proposed a number of further steps the German government should take in reforming its economy. In his speech he praised German efforts at reducing administrative burdens and the costs of starting a new business. He stated that the overall strength of the recent reform efforts was the determination to raise the country's innovative capacity. Citing the Commission's assessment of the 2005 reforms, Almunia highlighted the need for more competition in Germany, particularly in public procurement, in professional services, and in the provision of broadband services.

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Germany faces the additional long-term challenge of boosting its growth potential against the backdrop of unfavorable demographics—an aging population and a low fertility rate. One way to do this is to encourage business investment. Strong investment growth will lead to a faster expansion in the capital stock and a correspondingly strong rise in production capacities. In order to encourage future investment, Germany must continue its efforts in moderating labor costs and reducing the burden of restrictive labor laws. Although, lower growth in labor costs is unlikely to improve domestic demand, over the long-term wage moderation will help to strengthen and sustain Germany's competitiveness on the global market. If Germany continues to make progress, investment will continue to rise and consumer demand will benefit from greater growth in disposable incomes (Wharton Mar. 28 2007).

The ambitious measures set forth in the Agenda 2010 reform package have already done and will continue to do a great deal to prepare Germany for the age of global trade and competition. The lofty aims of delivering sustainable growth, full employment, stability, and security within Germany and the European Union, are desirable and deserving of the universal efforts of EU member states toward their achievement. Furthermore, in order to preserve Europe's uniquely high standard of living over the coming years, it is absolutely necessary that these issues be addressed and dealt with effectively. If carried through, these policy actions will continue to both shape the face of Europe positively and to serve as a model for nations adapting to a post-industrial economic structure for years to come.

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Mentor Comments

As Dr. Judith Ricker writes to recommend publication of Mr. Cheek's research in *Inquiry*, her enthusiasm is obvious.

Robert Cheek, a Chancellor's Scholar majoring in German, Economics and European Studies, has completed an exciting, original, and highly relevant research project. In keeping with his broad range of interests, he selected a multi-disciplinary project spanning half a century and involving all three fields titled "What Is Ailing the German Economy? A Critical Analysis of German Social Market Economics." This project allowed him to draw on information gained in relevant courses taken on this campus as well as in Austria, where he spent his junior year studying at the Karl-Franzens-Universität in Graz.

Ever since I have known him, Robert has been keenly interested in the economic situation in Germany. When time came for him to select a research project, he wanted to explore why the German economy had been stagnating for years. It was at a time when Chancellor Schroeder, a socialist, had tried to introduce badly needed changes but had continued to lose voter support. In a desperate attempt to solidify his position,

he called for early federal elections. Robert followed the heated debates about the future of the German economy that ensued and dominated the campaign against challenger Angela Merkel. All major and minor parties offered economic remedies. When neither major party won a solid majority, the country was thrown into turmoil. Ultimately, Schroeder stepped down. The coalition that was formed required compromises that made it difficult for Germany to push through the major changes necessary for the German economy to begin flourishing again. Robert had the unique opportunity to monitor policy changes as they evolved when the Merkel government took over the reigns.

As Robert researched his topic, he became more and more interested in the history of the German economy. Specifically, he wanted to explore why the *Wirtschaftswunder*, the "economic miracle" that had defined the post-war German economy, could not be duplicated in former East Germany after the unification.

In order to provide an answer to this question, Robert had to go back to 1945 to identify the factors that lead to the *Wirtschaftswunder* and explore the economic schools of thought that subsequently lead to the highly

successful Social Market Economy of the Federal Republic. It is to his credit that he looked beyond the myths surrounding the post-war German economic boom, studying instead the main theoretical bases for the Social Market Economy.

The next step was for Robert to assess the conditions that existed in the former German Democratic Republic, comparing them to the conditions in post-1945 West Germany, as well as the economic conditions in the old Federal Republic as the two Germanys were reunited. He identified the principle problems that prevented a second economic miracle from occurring and, along the way, identified what ails the German economy. He ended his study with an analysis of recent German strategies, principally Schroeder's Agenda 2010 reform package, to address the challenges that mature, post-industrial economies like Germany's face due to increased globalization.

Robert's project was very challenging. He read through a vast amount of sophisticated literature, both in English and in German that provided him with the background information he needed. The fact that had the language skills to read widely in both languages was critical for the project.

Appendix I



Source: International Monetary Fund. "World Economic Outlook: Spillovers and Cycles in the Global Economy." *World Economic and Financial Surveys* April 2007.

IMMIGRATION AND SUPPORT FOR ANTI-IMMIGRANT PARTIES IN COSTA RICA

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Abstract

The central research question of this work is whether large or growing immigration populations cause a rise in support for political parties espousing anti-immigration positions. Virtually all of the research on this topic has been focused on the United States and Western Europe. This study, by contrast, looks at the impact of Nicaraguan immigration into neighboring Costa Rica on support for anti-immigration parties in that country. Existing research has found links between such support and immigration levels, as well as other variables such as education, unemployment and ethnic diversity. After reviewing the literature, I generate a series of hypotheses based on previous findings. I also introduce a novel hypothesis which suggests that the relationship between immigration levels and anti-immigration party support may not be linear, as assumed in the literature, but rather curvilinear. Using local level data on immigration levels, socioeconomic characteristics and electoral results from the 2006 national elections, I first used regression analysis to test my hypotheses. In many cases, my findings from this analysis were inconsistent with or even contradictory to the existing literature. A second set of analyses provided preliminary support for the hypothesized curvilinear relationship. This work is designed to contribute to the literature in several areas. First, it marks one of the first efforts to analyze the dynamics of anti-immigration support in a developing rather than developed country. Second, it represents one of the relatively few attempts to explore the topic at the subnational rather than national level. Finally, it suggests the possibility of an entirely different type of relationship between immigration levels and anti-immigration voting than that assumed in the existing literature.

Introduction

Though there is considerable debate and controversy in this country surrounding the immigration issue, it is important to recognize that the U.S. is only one of many nations in this hemisphere dealing with immigration-related problems. In fact, in terms of the overall levels of illegal immigration as a proportion of the total population, other countries in the region may well have significantly larger illegal populations than we do.

One such country is Costa Rica, which has a long history of dealing with a large number of Nicaraguan immigrants who cross the northern border. These immigrants

migrate for both economic and political reasons, and as Costa Rica has both a relatively stable economy and the highest standard of living in Latin America, it is an appealing destination. The debate over immigration issues in Costa Rica parallels the debate currently taking place in the United States, and in both nations political parties accurately view immigration as an issue that has the potential to mobilize the electorate. However, though researchers have long examined the conditions under which explicitly anti-immigration parties are able to successfully mobilize electoral support, virtually all of this research focuses on receiving countries in the developed world. This study, by contrast, examines the issue in the context of immigration from one developing country to another (somewhat more prosperous) developing country. Specifically, this study will investigate whether there is a link between levels of Nicaraguan immigration at the local level and support for Costa Rican parties adopting anti-immigration policies in national elections. More specifically, it is hypothesized that high levels of Nicaraguan immigration will spur greater support among Costa Rican parties for adopting anti-immigration party planks.

Immigration and Popular Attitudes

Though the immigration policies of any given country are the product of many factors, clearly public opinion plays an important part in shaping such policies. As with any set of popular attitudes, particularly those related to "hot-button" issues, there is often a disconnect between the empirical effects of immigration on a receiving country and the public's perception of those effects. One consequence of this divergence between reality and perception has been the periodic ability of those favoring more restrictive immigration policies to frame the issue almost exclusively in terms of threats. Broadly speaking, the literature has grouped such threats into two general categories: cultural threats, which are identity-based, and economic threats, which are class-based.

Cultural threats are often more diffuse and less tangible than economic threats, and are rooted in a belief that an increase in the presence of a culturally different group will effectively undermine and perhaps even destroy prevailing cultural institutions. Research on the source of anti-immigrant attitudes resulting from perceived cultural threats is grounded in the broader sociological literature on group attributes. This literature specifically considers particular groups in terms of either their distinctive characteristics or specific experiences.

In other words, this research hypothesizes that sub-groups in a society will tend to have different attitudes toward immigrants based on who they are and what they have been exposed to. These attitudes arise, then, from issues of identity and values rather than material conditions.

There are several strands of thinking in the literature which focus on various factors related to the cultural threat hypothesis. One looks at the type of contact that occurs between the native and immigrant populations. Some researchers have suggested that both the type of contact incoming groups have with nationals and the time that the immigrant population has been at a certain level in the community shapes anti-immigrant opinion greatly (Cornelius 102-106). A second body of research argues that certain subgroups consistently react more favorably to an influx of migration within their communities. The concept of marginality states that groups outside the mainstream in any given locality are more receptive to newcomers. For example, Wilson has found that African Americans in the United States are more supportive of Hispanic immigrants, even though they may well be more economically threatened by such immigrants than the dominant Anglo population (Wilson 487).

In contrast to cultural threats, economic threats are linked to perceptions (which may or may not be factually valid) of competition between nationals and immigrants over scarce material goods or benefits. Since this competition is not evenly distributed in society, perceptions of economic threat tend to be related to class. The sorts of resources at the heart of this perceived competition fall into two general categories: market-based resources (jobs, wages) and state-based resources (government benefits/services) (Money 693-5).

There is still considerable debate in the literature over the empirical effects of immigration in both these areas, but in terms of support for anti-immigration policies, the perception of such effects matters more than the actual impact. These perceptions are strongly shaped by both prevailing economic conditions and the socioeconomic status of particular individuals. Consistent with the competition thesis outlined above, we would expect to see much higher levels of anti-immigrant sentiment during periods of economic recession than during a period of economic prosperity. The impact of increased competition resulting from recession on such sentiments, though, is not uniform in either socioeconomic or geographic terms.

For example, a number of researchers have found clear evidence that higher-skilled individuals are more tolerant of immigrants than lower-skilled individuals. This is due in part to the fears of many lower-skilled workers that immigrants will effectively push them out of their current jobs and take over the unskilled part of the job market (Mayda 516-25). Others argue it is the lower level of education found among people with low-skill jobs that fosters a hostile attitude toward immigrants, not job fears (Hainmueller and Hiscox 1). Either

way, it is clear from the research that a certain socioeconomic class (low skill, less education) in the native population is more prone to anti-immigrant sentiments than other groups.

In the same way that these sentiments will be variably distributed across social groups, we should expect them also to be distributed across communities. Specifically, we would expect that as the level of immigrants shifts in a given locality, public opinion toward immigration will change accordingly. Migrants do not spread out evenly and randomly in a country, but rather are spatially concentrated based on a variety of factors. Interaction between native and migrant populations will obviously be higher in areas with concentrated migrant populations and the immigration issue will likely become more salient in such localities (Money 690-91).

Though the literature on the relationship between immigration demographics and anti-immigrant attitudes or voting behavior is well-developed in certain areas, there are still important gaps in our understanding of the topic. One obvious gap is that virtually all of the research to date has focused on developed countries, despite the fact that a considerable amount of international immigration occurs within the developing world itself. This lack of coverage is especially obvious when it comes to research on support for anti-immigrant parties, which almost exclusively focuses on Europe.

In an attempt to fill this gap, my thesis will examine the case of Costa Rica, whose principal source of immigration, legal and otherwise, is its northern neighbor, Nicaragua. Whereas most research to date has focused on attitudes (opinion data) or behavior (voting data) at a national level, I will go into greater depth by examining the effect of immigration at a subnational level. Using a collection of unique data sets, I will explore the relationship between support for various immigration policies (and the parties that propose them) and levels of actual immigration demographics at a local level.

The existing literature may also benefit from additional research concerning how the relationship between demographic change and anti-immigrant attitudes has been conceptualized. The dominant hypothesis regarding this connection suggests that communities which are experiencing or have experienced large influxes of illegal immigrants would be more likely to support strong, and even harsh, anti-immigration policies, as well as the political parties that advocate such policies. In other words, we would expect to see higher levels of support (in terms of both public opinion and voting behavior) for anti-immigration policies in a more or less positive and linear relationship with levels of immigration within a given community. All of the research cited earlier uses this approach.

An alternative hypothesis would suggest that there might be a threshold in terms of this relationship and that after immigration reaches certain levels, support for anti-immigrant

policies or parties will actually decline. This hypothesis conceptualizes the relationship in a curvilinear rather than linear fashion, suggesting a 'tipping point' in terms of the link. In other words, after a certain point, the immigrant population level in a given community could reach such a magnitude that it might reverse the anti-immigrant tendency. This could be the result of a number of factors, including sheer statistics (i.e., the number of legal immigrants outnumber non-immigrants) or economic necessity (i.e., local dependence on immigrant labor).

My primary research question is twofold: First, is it possible to identify subnational variation in terms of attitudes toward immigration policy based on local levels of immigrant population? Second, is the relationship between such attitudes best described as linear or curvilinear in nature? My overarching hypothesis suggests that public support for anti-immigration parties will increase to a point in relation to local immigration levels, but will then decline as such levels reach a 'tipping point.' Before I turn to my specific research design, however, I first provide a brief overview of the immigration issue in Costa Rica as well as a description of the various positions taken by political parties in the debate.

Immigration Issues in Costa Rica

In order to understand the specific dynamics of Costa Rican public opinion toward Nicaraguan immigrants, and the ways in which these opinions sway law and public policy, we must first briefly examine the history of Nicaraguan migration into the nation. Nicaraguan seasonal and permanent workers have been entering the country in order to work Costa Rica's abundant banana and coffee crops since the turn of the 20th century. Since needs for additional migrant workers were being met at the beginning of the century, Nicaraguan migrants were welcomed, and even openly solicited, by these large agricultural industries (Cortés Ramos).

Today migrant workers continue to enter the country in sizeable numbers, largely due to the vast differences in the standards of living between Costa Rica and Nicaragua. However, while economic motives for migration have remained fairly consistent over the past century, the number of migrants moving to Costa Rica for political motives accelerated dramatically beginning in the 1960s, as civil war and political unrest in Nicaragua spurred a mass exodus from that country (Mahler 11). As a result of the ongoing political turmoil and economic crisis, the Nicaraguan immigrant population in Costa Rica doubled between the census years of 1973 and 1984, and then doubled again between 1984 and 1997.

Currently, about 250,000 Nicaraguans have official permits to live and work in Costa Rica, and in 1998, 11% of people born in Costa Rica had mothers who had been born in Nicaragua (Mok 44). It is extremely difficult to estimate the exact number of Nicaraguans in Costa Rica, due largely to the fact that statistics for undocumented immigrants are

sparse. However, scholars and statisticians put the number of Nicaraguan immigrants near 500,000; if these numbers are accurate, Nicaraguans make up between 1/7 and 1/8 of the entire population of Costa Rica (Mahler 11). Nicaraguan immigrant populations are concentrated along the Caribbean coast, in areas surrounding San José, and along the northern border regions of the country. Sixty percent of the immigrant population lives in urban areas, while 40% live in rural areas. This concentration in the capital city of San José, plus the transition of Nicaraguan immigrants from rural to urban workers, has caused the population to become more visible and subsequently, in the eyes of some, more threatening to Costa Rican nationals.

Increasingly, the historically tolerant Costa Rican public has come to view immigrants as the cause for increased crime, economic problems, and even infant mortality. These societal ills are obviously not solely the consequence of a growing immigrant community, yet Costa Rican nationals confronting such ills now appear more receptive to simplistic explanations which lay the blame for all that ails the country at the feet of Nicaraguan migrants. A mixture of nationalist and often xenophobic rhetoric, previously rare, has now become common in Costa Rican political discourse.

The pervasiveness of this surge in nationalistic hostility toward Nicaraguan immigrants is indicated by the sometimes vitriolic response of some members of the normally progressive intellectual class. For example, José Sobrado, a professor, lawyer, and newspaper columnist, compared immigration to AIDS and called it "a cancerous tumor." Social scientist José Luis Vega characterized immigration as an "anarchy" affecting the social system, undermining tradition, and threatening the economy (Sandoval García 436-438). Such attitudes have filtered into the general population as well. In a 1999 Costa Rican opinion poll, 17% of those polled felt that Nicaraguan immigration was the number one problem facing the country and over 60% supported the immediate deportation of undocumented immigrants (Mahler 12).

Negatively biased attitudes were at least in part the impetus behind the current *Ley Migratoria* (Migration Law), passed by the Costa Rican government in August 2005. The new law is a sweeping overhaul of previous migration laws, particularly in regard to tightening border security and increasing penalties for participating in or aiding illegal immigration. These penalties were extended for the first time to the actions of Costa Rican nationals who "abetted" illegal immigration. The new law also seeks to make immigration into Costa Rica less attractive by applying more restrictions and requiring that potential immigrants to prove their usefulness to society and Costa Rica as a whole. The *Ley Migratoria* includes a brief section regarding a need to guard against human rights violations, but outlines in much more detail national and international punishments for illegal immigration (CR *Ley* 8487).

The passage of the *Ley Migratoria* served as a focal point for the debate over immigration between political parties in the run-up to the 2006 national elections. Politicians saw the issue as one which had the potential to mobilize voters. Parties used the law as a reference point for developing more comprehensive stances on the immigration issue during the campaign. On the basis of these positions, I identified parties as "anti-immigration" if they campaigned with some combination of the following platforms: deportation of undocumented aliens, tighter restrictions on immigration, punishment for those aiding illegal immigrants, decreased asylum for refugees, and exclusion of immigrants from social programs.

In order to identify those parties who most closely fit the "anti-immigration" label, I first undertook a detailed and individualized assessment of the platforms of all of the Costa Rican political parties that fielded candidates at the national level in the 2006 presidential and congressional elections. The platforms, including specific questions regarding the immigration issue, were submitted by the parties and published on the website of the *Tribunal Supremo Electoral*. (http://www.tse.go.cr/pp_ini.htm) On the basis of these statements, I identified the following parties as falling into the "anti-immigration" camp: the *Partido Unión Nacional* (PUN), the *Partido Patrio Primero* (PPP) and the *Partido Unión Para el Cambio* (UPC).

Research Design

As noted earlier, my research was designed to address two separate but related questions. The first is whether a link can be identified between immigration demographics and support for anti-immigration parties at the local level. The second question addresses the nature of such a possible relationship. Most of the literature suggests a linear relationship, with support for anti-immigrant parties rising in direct proportion to the level of change in the size of the immigrant population. I will explore the possibility of a different type of relationship, namely one that is curvilinear, and will attempt to determine whether either type is supported by the data. What follows is a summary of the hypotheses suggested in the literature and a discussion of proposed methods for testing my research questions. Before that, however, a brief discussion of data sources is appropriate.

The dependent variable in this research is level of support for parties espousing anti-immigrant platforms. As noted earlier, I used formal campaign platform statements from the various parties to classify such parties. My dependent variable measurements specifically refer to the combined percentage of the valid vote obtained by the three anti-immigration parties identified earlier during the 2006 national elections for President and Deputies. These data were obtained from the website of the *Tribunal Supremo Electoral* (Supreme Electoral Tribunal), the governmental election agency. It is important to note that the vote totals for all of

the aforementioned parties are quite small in relation to other parties on the Costa Rican ballot and each of the parties did poorly, so the numbers being manipulated are relatively small and do not account for a large percentage of the total vote in any election.

My independent variables were gathered from two primary sources. The first is the InfoCensos website of the *Centro Centroamericano de Población* (Central American Population Center) at the University of Costa Rica, which utilizes data from the 2000 Costa Rican governmental census. The second is data from the Costa Rican government's *Encuesta de Hogares* (National Household Survey) from 2000 which was previously compiled in a dataset provided by Dr. Jeff Ryan. I turn now to a discussion of my hypotheses.

According to existing research, support for anti-immigrant parties and policies can be expected to change in relation to both relative and absolute demographic change. Relative change refers to the rate of increase of the immigrant population, meaning that a community that went from 1% to 2% would experience a 100% relative growth. Absolute change refers to the numerical growth in the population, meaning that the same community would experience only a 1% growth rate. The specific hypotheses related to demographic change are provided below.

H1: As the size of the immigrant community increases, the size of the anti-immigrant vote will increase.
Independent Variable: Percent immigrant population: percent of local immigrant population according to 2000 census.

H2: As the growth of the immigrant community rises in relative terms, the size of the anti-immigrant vote will increase.

Independent Variable: Percent change in immigration (relative): relative percentage increase in immigrant population 1984-2000.

H3: As the growth of the immigrant community rises in absolute terms, the size of the anti-immigrant vote will increase.

Independent Variable: Percent change in immigration (absolute): absolute percentage increase in immigrant population 1984-2000.

Education is another variable which may change support for anti-immigrant parties. The literature indicates that lower-educated members of the receiving country are more likely to support anti-immigrant parties than their more highly educated countrymen. Education-based hypotheses relevant to this study are:

H4: As the level of literacy increases across communities, the size of the anti-immigrant vote will decrease.

Independent Variable: percentage of local population over age 21 able to read and write.

H5: As gains are made in literacy rates over time, the size of the anti-immigrant vote will decrease.

Independent Variable: percentage change in literacy rate 1984-2000.

H6: As the number of school-age individuals enrolled in school rises, the size of the anti-immigrant vote will decrease.

Independent Variable: percentage of 5-24 year-olds who attend school.

H7: As the change in the rate of the percentage of the school-age population enrolled in school rises, the size of the anti-immigrant vote will decrease.

Independent Variable: school attendance rate change.

H8: As the percentage of the population with no education completed rises, the size of the anti-immigrant vote will increase.

Independent Variable: percentage with no education.

H9: As the percentage of the population with any level of primary education completed rises, the anti-immigrant vote will decrease.

Independent Variable: percentage of population with primary education.

H10: As the percentage of the population with any level of secondary education completed rises, the anti-immigrant vote will decrease.

Independent Variable: percentage of population with secondary education.

H11: As the percentage of the population with university education completed rises, the anti-immigrant vote will decrease.

Independent Variable: percentage of population with any level of university education completed.

Unemployment is also hypothesized to cause an increase in support for anti-immigrant parties. Consistent with the competition hypothesis, we would expect a positive linear relationship between unemployment and support, as noted in the following hypotheses.

H12: As unemployment increases in a society, the anti-immigrant vote will increase.

Independent Variable: percentage of total unemployment in a locality.

H13: As unemployment among youth increases, the anti-immigrant vote will increase.

Independent Variable: percentage of local population under 24 unemployed.

Service access is also a particularly important variable for anti-immigration viewpoints generally, and may be particularly sensitive in Costa Rica. Nicaraguan immigrants

are often portrayed by some parties as the cause of an erosion of these services, so support for anti-immigrant parties should go up as access to social services decreases. Two hypotheses address this factor.

H14: As social security is more widely present in a locality, the anti-immigrant vote will decrease.

Independent Variable: percentage of population with social security.

H15: As social security is more widely available over time, the anti-immigrant vote will decrease.

Independent Variable: change in percentage of the population with social security.

The level of ethnic diversity of a population may also be related to support levels for anti-immigrant parties. The literature indicates that some groups are more receptive to immigration than others, namely groups outside the mainstream, such as minority groups. Traditionally excluded Costa Rican ethnic groups (e.g. Afro-Costa Ricans, Asians and Indigenous) might therefore be expected to have a less hostile attitude toward Nicaraguans, who are generally characterized as darker-skinned and ethnically distinct from the stereotypical light-skinned Costa Rican. Thus we would expect that higher levels of ethnic diversity should decrease anti-immigrant party support, as more diverse populations may be more accepting of immigration. My final hypothesis considers the projected impact of diversity increases on voting.

H16: As diversity increases, or the 'non-white' population increases, the anti-immigrant vote will decrease.

Independent Variable: percentage of Indigenous, Asian, and Afro-Costa Rican population.

These variables are those which are discussed in the most detail in the literature. Three other variables which were tested for significance were poverty rates, urbanization and internal migration, for which existing research provides no clear guidance in terms of hypothesis generation. The following article sections describe the process of data analysis and testing of the 16 hypotheses formulated for this study. Given length constraints, only key findings can be discussed briefly in this article.

Analysis

The initial phase of data analysis involved a series of regression models designed to account for the differences across local districts, or *cantones*, in terms of support for anti-immigrant parties. Costa Rica has 81 *cantones* which are roughly the equivalent of municipalities. Linear regression models were estimated using both dependent variables (vote totals for all anti-immigration party candidates at the presidential and congressional, or *diputado* levels) with all of the possible independent variables.

Table 1. Variable clusters in terms of significant contributions to regression.

Variable	Rarely/Never Show Significance*	Occasionally Show Significance*	Almost Always Show Significant*
Unemployment	✓		
% Immigrant Population	✓		
Poverty	✓		
% Change in Immigrant Population (Relative & Absolute)		Variable	
Social Security		+	
School Attendance		+/-	
Education Level Completed Secondary		-	
% Living in Substandard Housing		+/-	
Log: Total Population		+	
Net Loss/Gain in Population 1995-2000		-	
Literacy Rate			Usually +, sometimes -
% Urban Population			+
% Non-White Population			+

Most of the models produced relatively meager results. For reasons of space, I don't report the results of all of the models I tested. Generally speaking, though, the analysis indicated the following. With regards to the dependent variables, models with the presidential electoral statistics are much more robust than models using congressional electoral results. In all of my estimations, the former indicated higher R-squared figures than the latter.

In terms of the independent variables, the successive model runs indicated that certain variables consistently fell into one of three categories: those that nearly never achieved significance, those that occasionally did and those that routinely achieved levels of significance. These variables, and the direction of observed relationships (positive or negative) are shown in Table 1.

What emerged from successive model runs was a clear indication that many of the independent variables, including those most prominently cited in the literature, have little explanatory power in the Costa Rican case. Certain variables did, however, demonstrate significant explanatory value. Taking these results into consideration, the "best" models were selected on the basis of both the amount of variance explained (R²) and the significance levels of the independent variables (See Tables 2 and 3).

In examining these models, a number of anomalies were apparent. For example, the trends in the Presidential model are actually reversed in the Deputies (congressional or legislative) model. The relationship between literacy and the anti-immigration vote for president is positive, for deputies it is negative. Indeed, we see a similar reversal of direction in each of the independent variables save for Secondary Education and 'Non-White' population. This is obviously a curious finding. A tentative explanation would posit that voters may more clearly express their preferences in regard to the

immigration issue in their presidential vote, which could also account for the significantly higher R-squared value in that model.

In terms of what the findings tell us relative to existing research, the results are ambiguous. Perhaps most confusing are the results for education-related variables, where two measures (School Attendance and Secondary Education) are consistent with the literature, while a third (Literacy) is completely contrary to expectations. Another finding inconsistent with the literature is that, as the relative change in immigration accelerates, anti-immigrant party support declines. The literature asserts that change in immigration, or a surge in immigration, has been shown to exacerbate anti-immigrant sentiments. Likewise, the finding that as ethnic diversity increases, support for anti-immigrant parties also increases, runs counter to the literature. Finally,

while little research has been done on the effect of urban vs. rural demographics on public opinion about immigration, the

Table 2: Dependent Variable: All Anti-Immigrant Presidential Vote 2006

	B	t	Sig
(Constant)	-23.561	-4.216	.000
Percent Change in Immigration (Relative)	-.074	-2.352	.021
Literacy Rate	.374	4.921	.000
% 'Non-White' Population	.020	3.053	.003
% 5-24 Year Olds Who Attend School	-.109	-3.024	.003
% Urban Population	.018	2.700	.009
% Secondary Education (Any level completed)	-2.753	-1.982	.051
Adjusted R ²	0.514		

Table 3: Dependent Variable: All Anti-Immigrant Deputies Vote 2006

	B	t	Sig
(Constant)	-77.199	-4.524	.000
Percent Change in Immigration (Relative)	1.100	2.038	.045
Literacy Rate	-.543	-1.726	.089
% 'Non-White' Population	.861	4.880	.000
% 5-24 Year Olds Who Attend School	.064	3.771	.000
% Secondary Education (Any level completed)	-5.849	-1.696	.094
% Living in Substandard Housing	.224	1.864	.066
Adjusted R ²	0.270		

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present study finds that, as the percentage of the population living in community urban areas grows, support for anti-immigration parties increases.

One issue not yet discussed relates to the nature of a possible relationship between my immigration-related independent variables and my dependent variables. As noted earlier, one question I hoped to address was whether the relationship between immigrant population patterns and anti-immigrant party support is best described as curvilinear. In the models reported thus far, immigrant population levels/changes in population did not seem to explain much of the variance in my dependent variables. The standard regression models used in this study can only discern linear, as contrasted with curvilinear, data trends. Given the weakness of the immigration-related variables in the regression model used here, it is possible that non-linear patterns were present. Discussion of the analysis techniques used to explore curvilinear patterns is beyond the length and scope of the present paper. However, I do present a series of scatter plots which both give a graphic representation of the data and allow comparisons of the predictive power of linear versus non-linear explanations or trends, at least for a single explanatory variable at a time (see Figures 1 to 3).

For each figure, both linear and quadratic (curvilinear) lines were plotted against the data, with the R-squared value indicating how much variance is explained by each of the two lines. Only the immigration-related variables of absolute percentage, absolute change, and relative change of immigration are plotted against the dependent variable of anti-immigration vote for president. While both linear and quadratic functions on these graphs have low R-squared values, the values are consistently higher for the curvilinear line.

Figure 1: % Immigrant Population and Anti-Immigrant Presidential Vote

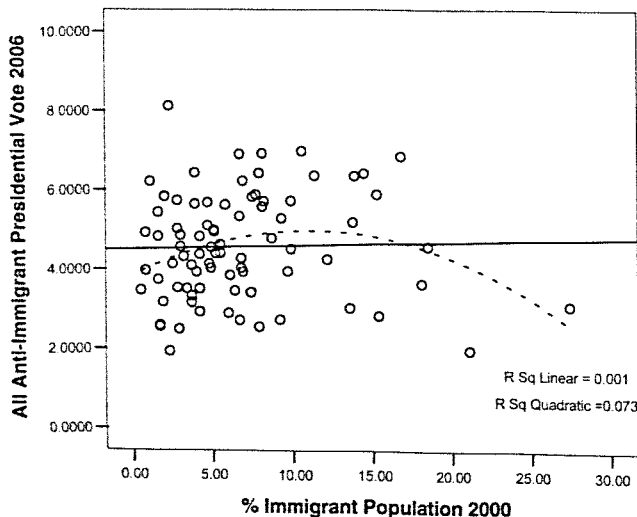


Figure 2: Relative Immigrant Population Change and Anti-Immigrant Presidential Vote

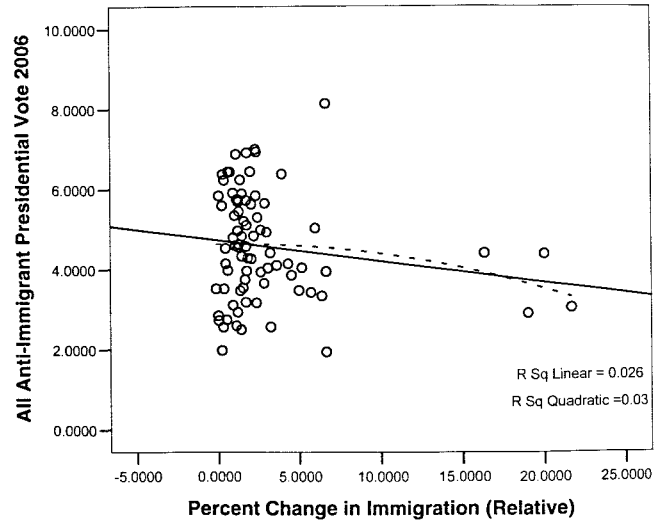
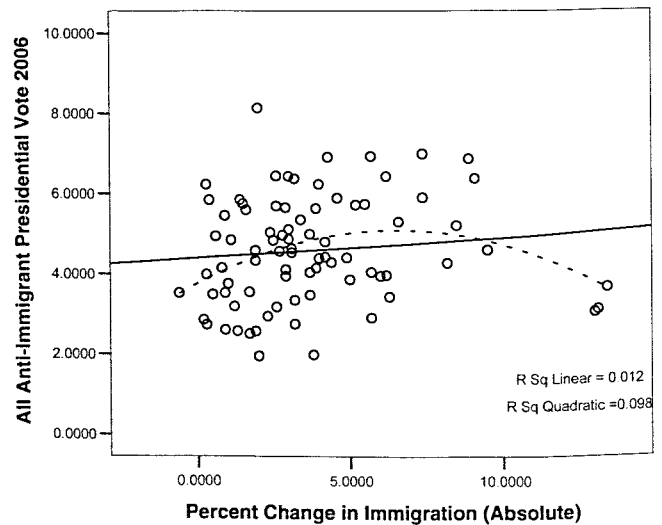


Figure 3: Absolute Immigrant Population Change and Anti-Immigrant Presidential Vote



Conclusions

As noted at the outset, this study was designed as part of a broader body of research on the relationship between changing immigration demographics and anti-immigration party support. On the basis of these data, it appears that few of the patterns which have been identified in the literature are supported in the case of Costa Rica. In fact, in some instances, my findings not only fail to support the expectations of existing research on developed countries, but actually directly contradict such expectations. Also, some of the variables (e.g., unemployment) which have repeatedly been shown to be robust predictors in that body of research fail more or less

completely in the case of Costa Rica. Most notable in this regard were the unemployment and social security variables.

In addition to finding no support for some important variables in the literature, this analysis found significant support for a variable that is never addressed in existing research: level of urbanization. The positive relationship indicated in my results suggests the possibility that immigrant communities are more conspicuous in urban as opposed to rural areas, and that such heightened visibility may sharpen perceptions of competition over resources. A further discrepancy between my results and the literature involves findings where the effect of an independent variable is in the opposite direction of that predicted. This is clearly the case with regard to ethnic diversity, which appears to be positively rather than negatively related to anti-immigration sentiment. One possible explanation for this finding is that in Costa Rica, diversity actually fosters racial animosity which might then be easily translated into anti-immigrant attitudes.

Perhaps the most confusing outcomes are the sharp inconsistencies across different variables which ostensibly measure the same thing. As noted earlier, this was the case with regard to education-related variables. There is no immediately obvious explanation for the clearly counter-intuitive finding that increasing literacy produces more anti-immigrant support other than to suggest that may be a poor indicator or that the data is somehow flawed.

Finally, the findings with regard to the immigration demographics variables that are at the heart of this study are also far from straightforward. The only one of these variables that proved significant in the regression models was the relative growth measure, which operated in the opposite direction from expectations. Though these findings appear at odds with my argument that links immigration levels to anti-immigrant party support, it is possible that they provide indirect support for my hypothesized curvilinear relationship. As noted earlier, scatter plots indicated that for all three immigration-related measures, a quadratic curved lines provided a better predictive fit than did linear ones. Obviously, scatter plots are an imperfect tool for evaluating the strength of the underlying relationship, but the information provided by those plots is the closest that we can come in this study to alluding to the existence of a curvilinear trend.

The ambiguous and occasionally perplexing findings of this analysis indicate quite clearly the need for additional research. Nonetheless, this present study has attempted to contribute to the debate in several important areas. First, it marks one of the first efforts to analyze the dynamics of anti-immigration support in a developing country. Second, it represents one of the relatively few attempts to explore the topic at the subnational rather than national level. Finally, it suggests the possibility of an entirely different type of relationship between immigration levels and anti-immigration voting than that assumed in the existing literature.

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Mentor Comments

In supporting the publication of Ms. Churchill's study of factors influencing anti-immigration parties in Costa Rica, Dr. Jeffrey J. Ryan describes her work as the epitome of what the University of Arkansas strives for in supporting undergraduate research.

I am writing on behalf of Adrielle Churchill's submission for publication in Inquiry. I have known Adrielle since she arrived here at the University of Arkansas four years ago and have served as her Honors Thesis Chair. Her project, which was funded in part through a SILO-SURF grant, is one of the most innovative and challenging that I've been involved

with. The research she produced, furthermore, is relevant not only to the academic debate over immigrations issues, but to the ongoing policy debate over such issues as well.

Adrielle's work, which explores the linkages between changing levels of immigration and electoral support for anti-immigrant parties, makes at least three important contributions in this area. First, while there is a reasonably large body of literature dealing with the source of anti-immigrant attitudes in the United States and Europe, that topic remains almost totally unexplored in areas outside the developed world. Adrielle's thesis marks the first attempt that I am aware of to examine the phenomenon of immigration from one developing country (Nicaragua) to another developing country (Cost Rica). Second, even within that established literature focusing on the developed world, there are only a handful of studies that I know of which deal with the subject at a sub-national (i.e., local or regional) level rather than at the national level. In using local cantons (municipalities) as her basic unit of analysis, Adrielle is able to produce a much more nuanced analysis of the relationships she investigates than would have been possible had she used aggregated national level data.

Finally, in the course of developing her project, Adrielle elaborated what I believe to be an extremely novel and potentially very important hypothesis. As noted, her basic research question focused on the relationship between local levels of immigration and prevailing levels of support for anti-immigrant parties within a given community. The explicit assumption in every piece of research that I have seen is that the relationship between whatever explanatory variables are being tested and those support levels is linear. In other words, existing hypotheses all share the basic premise that increases or decreases in the value of the independent variable (e.g., education, immigration levels, diversity, etc.) will produce corresponding changes in the level of support in a direct linear fashion. Adrielle, instead, suggests the possibility of a curvilinear relationship, such that anti-immigrant attitudes will rise in proportion to immigration levels only up to a certain point, but that once a sort of 'critical mass' of immigrant population is reached, such attitudes will actually decline. Though for several reasons, including data availability and statistical complexity, she was unable to perform a rigorous test of this hypothesis, she did find some evidence strongly indicating that curvilinear models provide a more robust explanation of the relationship than do linear ones.

The implications of this last innovation are potentially far-reaching. Confirmation of the curvilinear hypothesis could in a very real sense revolutionize our thinking in this area. Beyond that is the possibility that such new knowledge could be put to practical use in identifying those communities most likely to become receptive to xenophobic or extremist appeals, perhaps

allowing for early intervention designed to mitigate social polarization in these vulnerable localities.

I believe Adrielle's thesis represents the very best of what we look for in undergraduate research: intellectual challenge, rigorous and innovative scholarship and relevance to a community which goes beyond narrow disciplinary boundaries.

LITERARY, HISTORICAL, AND SOCIO-ECONOMIC DIMENSIONS OF RACE AND IDENTITY IN THE DOMINICAN REPUBLIC: A NATIONAL DELUSION?

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Abstract

The article discusses race, racism, and self-concept in the Dominican Republic. It explains the reasons behind the present view of race, identifies links between race and Dominican economic and political issues, and explores how the unique situation of the Dominican Republic in terms of cultural history and geography has contributed to racism toward Haitians. The article also deals with the negative self-image many Dominicans have as a result of the color of their skin and their ancestry. In conclusion, it offers suggestions on revaluing race that could be applicable to not only the Dominican Republic, but also racially-segregated groups of individuals elsewhere.

Introduction

Prejudicial acts and racist comments toward Haitians occurred daily in places I visited in the Dominican Republic. Officials at Pontificia Universidad Católica Madre y Maestra, for example, would not let a group of Haitians into the computer lab. There were three African-Americans at the back of the group; once they identified themselves as Americans, the officials allowed only those three to enter. An African-American friend of mine was in a public car called a *concho*, similar to an American bus that picks up people on designated routes for low fares, that was full of Haitians. The driver of another *concho* drove by, full of lighter-skinned people. At a stoplight, the two drivers had a conversation about how lucky the one with the "*blancos*" was and how unlucky the one with the "*negros*" was. It is possible that these drivers were simply uneducated or ignorant, but it could also be the case that they only repeat the prejudicial traditions of the culture in which they have matured. As a result of stereotyping and overall prejudice against dark-skinned people, institutionalized and non-institutionalized racism seems to be over-arching themes of everyday life in the present-day Dominican Republic.

After watching numerous scenes of unfounded prejudice play out day after day against dark-skinned people in the Dominican Republic, I came to ask why blatantly discriminatory behavior developed among people at all levels of society and where it originated. It is particularly confounding that, although almost all Dominicans have at least a little "*negro tras de la oreja*" (black behind the ear)¹, prejudice against Haitians, African neighbors, co-workers, and

even darker family members is not only acceptable, but taught, modeled, and expected in a number of Dominican families. I will explore the origin of such thinking and how these thoughts influence Dominican life.

The Dominican view of race is a very complex issue that spans external and internal factors, time, and place. Geographical, political, cultural, and economic factors interrelated with history and literature have played a vital role in the Dominican formation of racial views. I explored race by speaking with Dominicans, Dominican Americans, and Haitians, as well as with fictional author Junot Diaz, a Dominican-American. I also studied Dominican literature from 1882 to the present and consulted literary and historical resources.

Working Definitions of Race & Racism

Although in the past the term "race" was used to imply a difference in peoples who shared certain characteristics, or in whom particular genes recurred frequently (Mörner 3), it has been argued more recently that race is a social construction rather than a biological truth. Peter Wade (2003) points out that scientists have now discovered that there are "no biologically defined entities called races" (185). He states that although certain patterns in looks and behavior are attributed to genetics, there are no biological differences among "races." Mörner found that racial mixing is not of true importance in a biological sense, though it is certainly important in a psychological sense. Racism may be simply defined as prejudice or discrimination based on one's conception of another's "race." Prejudice may be defined as antagonism toward an "other" group of people based on a negatively perceived generalization of some sort, while discrimination is one group's denial of uniform treatment to others based on these generalizations (Mörner 7).

Dominican Race and Ethnicity: A Multidisciplinary Approach

The majority of racial issues in the Dominican Republic are linked with the country's historical and political relations with Haiti and the establishment of slavery by Europeans. Over many years, numerous Dominicans have developed a fear, distrust, and aversion for Haitians. Since Dominican and Haitian people share their African heritage, the Dominican dislike of Haitians has turned into denial of national and individual history and ancestry.

Economic Disparity

Haitians, in particular, have moved to the Dominican Republic for numerous reasons. Overall, the Dominican Republic has historically been more stable than Haiti, its wages are higher, the education system is more respected, and the population is smaller in comparison to the size of the country. While riots are bound to take place at any given time in Haiti, particularly in the capital Port-au-Prince, the Dominican people are considered to be relatively calm, even in the capital Santo Domingo. In Haiti, the average annual per capita income is 1,500 U.S. dollars, while in the Dominican Republic it is 6,300 U.S. dollars (World FactBook 2006). Although the Dominican Republic makes up two-thirds of the island of Hispaniola, it has a population of 8,950,034, compared to Haiti's occupation of one-third of the island with almost the same number of people: 8,121,622 (World FactBook 2006). In short, fewer resources are spread over a larger population in Haiti than in the Dominican Republic.

Despite the opportunities for a better life in the Dominican Republic, there are a number of reasons Haitians hesitate to move to the Dominican Republic. The claims of better wages paid by Dominican sugar mill owners do not always prove to be true. Although the owners earn large profits, they pay their laborers minimal amounts. The poorest half of the Dominican population claims less than one-fifth of the gross national product, while approximately forty percent of the national income goes to the wealthiest ten percent of the people (World FactBook 2006). Cane-cutters in the Dominican Republic receive some of the lowest wages and are often subjected to conditions analogous to those that existed during the slave era. Although Haitian immigrants move to a land where greater supplies of resources should theoretically be spread over a smaller number of people, they frequently do not enjoy the benefits. Sometimes Haitians are brought from Haiti to the easternmost part of the Dominican Republic (commonly to La Romana), far from their homeland. They then have no way to return to Haiti, because they do not know where they are, do not speak Spanish, and do not earn high enough wages to afford bussing back to Haiti.

Politics and Economics

Although the political scene in the Dominican Republic is significantly calmer than it is in Haiti, Haitians have no political sway in the Dominican Republic. In fact, even third and fourth generation Haitian-Dominicans often do not have Dominican citizenship. The Dominican constitution decrees that people become citizens through *Jus soli*, i.e., children receive Dominican citizenship if they are born on Dominican soil, no matter which nationality their parents claim (Cedeño 139). There are two exceptions, however. The law excludes legitimate children of foreigners living in the country for diplomatic reasons and those who are "in transit". Since "in transit" is never defined, corrupt Dominican authorities can deny citizenship to whomever they wish for

as many generations as they wish (Cedeño 139). In the past, Dominican authorities have sent Dominican-Haitians "back" to Haiti even though they had never lived there. In reality, then, life is not easier for Haitians in the Dominican Republic than for those in Haiti.

For those Haitians who move to the Dominican Republic to attend college, benefits do seem to follow. There were a number of Haitian students at Pontificia Universidad Católica Madre y Maestra (the top ranking university in Santiago, Dominican Republic). According to world standards, Dominican schools are much higher ranked than Haitian schools. In comparison to other Haitians living in the Dominican Republic, Haitian college students are more respected because they arrive with money, are educated to some degree already, usually speak English and Spanish, and have the potential to add to the Dominican Republic's resources in the form of human capital, rather than remove resources by taking jobs from the lowest level of Dominican society. Nevertheless, these Haitian students are still second class citizens due to their nationality and skin color.

Perhaps the greatest drawback for Haitians who consider moving to the Dominican Republic today is the overt and covert racism they are bound to experience. Denial of citizenship is only one form of institutionalized racism encountered. Haitian-Dominicans are often not allowed to vote, not only due to an inability to claim citizenship, but also due to an inability to obtain a personal identity card, called a *cédula*. Dominicans must have a *cédula* in order to vote, but to obtain one, one must have enough money to be able to purchase the necessary documents to prove birth status (Howard 47). Haitians, as well as Dominicans from rural areas, often lack such documentation (Howard 47), due both to financial constraints and to the fact that many, if not most, babies are born with the help of a wet nurse in the home, rather than in a hospital. Even with proper birth status documentation, many Haitian-Dominicans choose not to approach officials for fear of deportation.

There is no significant support for Haitian-Dominicans who want to participate in politics either. Fair-skinned candidates have been continually favored over dark-skinned candidates. As an example, in 1996 an opinion poll revealed that nine percent of the electorate would not vote for the darker skinned presidential candidate Peña Gómez because they believed that he was of Haitian ancestry, eleven percent stated that skin color would influence their vote, and more than twenty percent admitted that racial characteristics were important in electoral choice (Howard 153).

Over the years, Haitians have been invited by the Dominican government to fill open positions in the cane industry in the Dominican Republic and, subsequently, have been forcefully returned to Haiti when new leaders took over the government or more Dominicans needed jobs (Charles 151). Beginning with a contract between the Haitian and

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Dominican governments, in 1952 the Dominicans "bought" 16,500 Haitians to work in the cane fields. By the 1970s, the Dominican Republic was paying up to \$3 million to Haiti per year for cane laborers (Wucker 105). Several leaders have executed Haitians as well. For example, Rafael Trujillo (to be discussed later) ordered several thousand Haitians killed in 1937 in order to "whiten" the Dominican population (Howard 31). In censuses, physical features have been used to label people either as Haitian or Dominican. In a 1981 census, there was a category called "*negro haitiano*" (Charles 151). This is significant because it distinguishes between those of African descent who are of Haitian nationality and all others of African descent. This illustrates that racism was institutionalized by the government, making it easier for people to accept. It also proves that black skin was tied to Haitian ancestry on government records and in the mind of every Haitian and Dominican person in the Dominican Republic.

The Trujillo Regime

Although there are a number of forms of institutionalized racism still in effect today, many scholars believe that the Rafael Trujillo dictatorship demonstrated the most horrendous examples of it. From 1930 through 1961, Rafael Leónidas Trujillo Molina created a regime based largely on racist thought and discriminatory practice. Trujillo came from a poor family, but worked his way up the military ranks while the United States was occupying the Dominican Republic from 1916 to 1924 (Wiarda 35). Although Trujillo was of Haitian ancestry, he expressed personal hatred toward Haitians and people of African descent. His maternal grandmother was the illegitimate daughter of the Haitian woman Diyetta Chevalier and a Haitian Army officer (Crassweller 27). It is unknown whether Trujillo denied his own ancestry, but sources describing his ancestry are abundant; thus, it is unlikely that he was able to successfully conceal or deny his ancestry if he tried to do so.

Trujillo implemented an entire political movement with the intent of bringing more white people to the Dominican Republic, pushing Haitians out of the country, and bettering the infrastructure in order to bring more unity to the country and to be more respected in the rest of the world. His program came to be called "Dominicanization" and its purpose was to reestablish "Dominican roots" and rid the country of Haitian influence. Trujillo revived the Dominican superiority complex, emphasizing that Dominicans were Catholic, Hispanic, and white, while Haitians were voodoo adherents, Creole-speakers, and black Africans. One tangible part of "Dominicanization" included deporting 8,000 Haitians (Wucker 47) and killing 12,000 to 18,000 Haitians (*el corte*) in 1937 and encouraging Italian and Japanese people to migrate to the Dominican Republic in order to "whiten" the society (*blanqueamiento*) throughout the 1930s (Howard 31). Trujillo constructed a number of highways to bring unity to

the country under his dictatorship. Once that was achieved, the corps of Frontier Cultural Agents distributed propaganda that explained and supported Trujillo's Dominicanization program (Howard 157). *Trujillismo* even became an important part of school curricula; one textbook recorded the following:

Haiti is inhabited by a mob of savage Africans. We Dominicans should be in debt to our own blood. The Haitian is an enemy. Haitians should be transferred to French Guyana or to Africa. The Dominican race and civilization are superior to that of Haiti. Haiti has no importance in the world. The poorest sectors of the Haitian population are an ethnic group incapable of evolution and progress. (qtd. in Howard 38)

Although Trujillo used Haitian laborers to staff the sugar plantations, from which he personally profited (Howard 25), he tried to indoctrinate the Dominican people with the belief that Haitians were hurting the society by bringing in unattractive physical features, poverty, lack of education, and voodoo. In fact, this was one of his justifications for his administration's killing of twelve to eighteen thousand Haitians or Dominicans of Haitian descent in 1937 (Howard 29). Trujillo's mindset and actions as a president led to extreme forms of institutionalized racism during his time as the country's leader, and some forms, such as denial of citizenship to Haitians, live on today.

Religion

Many negative religious generalizations are applied to those who are *negro* or *haitiano*. Dominicans associate themselves with Catholicism, while they associate Haitians with voodoo, even though both countries practice forms of Catholicism mixed with African beliefs. Ninety-five percent of Dominicans and eighty percent of Haitians claim Catholicism (World FactBook 2006). In Haiti, voodoo is openly practiced alongside Catholicism by about half the population. In the Dominican Republic, people do not usually admit involvement in voodooist or witchcraft practices. To the Dominican people, Dominican *brujería* (witchcraft) is known as *magia blanca*, or white magic, while Haitian *vodú* (voodoo) is known as *magia negra*, or black magic (Howard 36).

Many Dominicans deny any involvement in *brujería* or voodoo, although most of them believe at least in the *santos*, combinations of African deities with Catholic saints (Howard 93). Dominican and Haitian religious practices have much in common from an objective standpoint, yet practitioners of the religious practices in each of the countries use this as still another point of contention. Voodoo was originally spelled *vo du*, possibly coming from the language of the Fons tribe. *Vo* means "introspection", and *du* means "into the unknown" (Rigaud 8-9). Voodoo worship ceremonies always point to symbols of the sun, and ancestor worship composes a large portion of its rituals (Rigaud 11). The Haitian "religion" contains aspects of a number of African tribes as well as

Catholic influences from Europe, but some overarching themes within voodoo explain Haitian thinking to some extent.

Anthropological Studies on Race

As a result of this history, non-institutionalized racism pervades every aspect of life in the Dominican Republic. Anthropologist David Howard (2001) conducted surveys in four neighborhoods in the Dominican Republic and recorded his results. Howard's findings cannot be generalized to the entire Dominican population, since his polls were completed only in four neighborhoods. Approximately twenty percent of the interviewees from Santiago de los Caballeros, a city of about 550,000 in the northern part of the country, said that they did not think Haitians should even be allowed to work in the Dominican Republic (34). This reveals nationalistic tendencies and reflects the difficult economic situation in the Dominican Republic. Although Dominican frustration with Haiti has escalated over the years due to governmental relations alone, part of the problem is that Dominicans in the lower levels of society think that they could receive higher wages if they did not have to compete with Haitian laborers who are willing to accept lower wages.

Nationalism and a desire to keep a country's jobs with that country's people is not unique to the Dominican Republic. Even here in the United States, where life is comparatively better for even the lowest classes, Americans complain that foreign laborers are taking jobs away from them and depress wages. This argument is not economically sound from a free-market point of view. When left alone, consumers will allocate resources most efficiently within the economy by buying the least expensive products. Companies will efficiently allocate resources by hiring people who will do the work assigned for the lowest wage possible. In the long run, people are able to buy the products that are being produced by the laborers receiving less money and companies are able to pay less to produce their products, consequently saving money. The companies using these laborers and the average consumer can then put more money into the economy elsewhere. They may invest in their own or other businesses, which creates new jobs. Those who were jobless due to migrant workers would then have jobs. In the case of both the United States and the Dominican Republic, migrant workers should probably be appreciated. They allow nationals not to have to work at extremely undesirable jobs and save money on the products they are purchasing.

Just short of half the people with whom Howard spoke thought that Haitian laborers should be allowed at least some form of legal residency, while about half of them rejected without condition any notion of allowing Haitians to have residency in the Dominican Republic (36). Against the historical background, the figure of 50 percent of Dominicans thinking that Haitians should be allowed some form of legal residency seems high. This may reveal that Dominican society is moving toward a new degree of acceptance for Haitians,

albeit slowly and minimally. Some of the Dominicans view Haitians working and living in the Dominican Republic much like their forefathers did, but the percentage of Dominicans opposed to Haitians living and working in the Dominican Republic seems to be decreasing over time. Research is needed to confirm these trends and explore contributing factors.

Dominican Denial of Black Ancestry

Howard does not expound on the idea of Dominican denial of "blackness," possibly because he was culturally sensitive and knew that Dominicans would be offended by questions about race. However, this denial of one's own race is quite noticeable even to the most casual observer in the Dominican Republic, and numerous historians and fictional authors have documented it. Carolee Charles notes that Dominicans of all classes and backgrounds have come to use the same vocabulary to describe themselves and one another. The term *blanco* (white) is used to label lighter-skinned Dominicans and may be modified as *blanco trigueño* (wheat-colored white), *blanco rosadito* (pinkish white), *blanco acentado* (accented white), *blanco leche* (milk white), *blanco destinado* (white-maybe destined?), *blanco blanquito* (very white white), or *blanco jabao* (white-maybe soap?) (150). Actual "pure white" people are often called blonde-haired people, or *rubios*. The term *indio* has come to signify what would be *negro* in others' minds. People may be described as *indio claro* (clear Indian), *indio canelo* (cinnamon-colored Indian), *indio chocolate* (chocolate-colored Indian), or *indio oscuro* (dark Indian). In describing others, Dominicans sometimes use more descriptive forms of *indio*. Those who seem to be "pure black" but are more accepted due to their wealth, education, or background may be called *indios* of some shade or sometimes *morenos*, those who are "pure black" but not accepted (usually as a result of Haitian ancestry or occupation) are labeled *negros*. Black people are usually labeled *Haitiano*, regardless of whether they are Haitian, if Dominicans have no knowledge of them otherwise. According to Charles, "*en realidad, se considera que ser negro es idéntico a ser 'haitiano.'*" (In reality, being black is considered identical to being 'Haitian' 151). In everyday life, these terms may be used in a variety of ways. People frequently use the term *indio* to describe themselves in casual conversation. For example, my Dominican host sister compared her skin with mine, stating that she and her mom were *indios*, while I was a *blanquita* (white girl).

Other Generalizations about Haitians

A number of Dominicans think of Haitians in terms of various stereotypes and generalities. Often, Dominicans associate Haitians with AIDS, promiscuity, unemployment, and the inability to understand birth control (Howard 158). It is not uncommon to find Dominicans who express anxiety about being around Haitians because they feel that Haitians are likely to do others harm. A Dominican mother in *el*

*campo*² told her daughter not to go out of the house past a certain hour, as there might be Haitians hiding in the bushes that would hurt her. In poetry, music, and other forms of art, dark-skinned women, particularly Haitian women, are depicted as sensual and known to lead good men to ungodly activity, while fair-skinned Dominican women are depicted as innocent, submissive virgins. "La Mulata" (1849) by Francisco Muñoz del Monte, for example, portrays this image exactly (Howard 125)³.

Racism's Functionality

Since colonial times, there is a hierarchy in many countries, with blacks at the bottom, medium shades in the middle, and whites at the top. In the Dominican Republic, miscegenation occurred early on, and the Spanish crown even encouraged marriages between Indians and Spaniards. Today, this history has translated into a Haitian population at the bottom of the society with a color continuum of Dominicans above them. Color is only one indication of class, but if people are of a higher class, they may be labeled as having lighter skin. Research, real-life experiences, and poetry emphasize this color continuum and how the Dominicans use it within their society to separate into groups.

Racism is partially fueled by long-lived economic insecurity. Within the bottom levels of society, people always find a way to distinguish between the low, lower, and lowest classes. Instead of earning power, nationality and race determine one's rank. (Of course, black Haitians are at the very bottom.) The social hierarchy in terms of acceptance, respect, prestige, and usually earning power probably looks something like the following schematic shown in Figure 1.

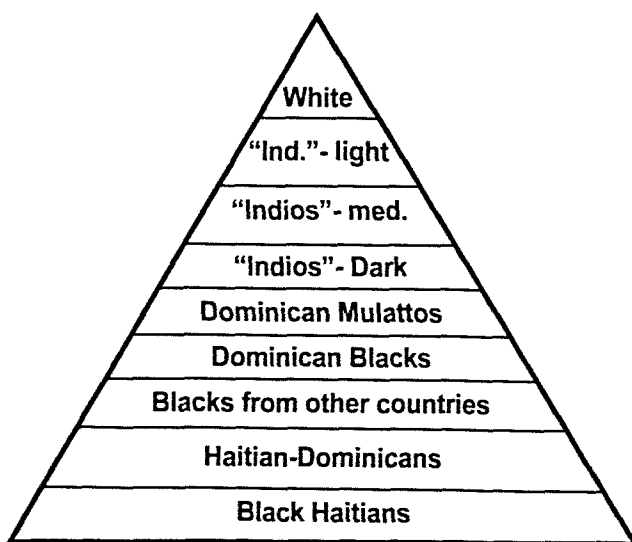


Figure 1. Social hierarchies of racism in the Dominican Republic.

Racism is still functional for the Dominican people. It provides a form of differentiation in a society composed largely of poor people. It also keeps Haitians or people of Haitian descent in the lowest paying jobs, unable to advance in the country or even within the confines of a company.

Revaluing Race

Much could be done to encourage the people of the Dominican Republic to revalue race. Of first priority in my mind is decreasing economic inequality and bringing the median of the population up to a standard of living above the poverty level. Multinational companies that have operations in the Dominican Republic could pay workers higher wages. New multinational companies could invest in plants in the Dominican Republic, creating new jobs., greater opportunities, and possibly higher educational levels for all people, which could result in greater equality.

Giving people new access to capital in the form of business loans could help them become entrepreneurs and have more earning power. Micro-lending to improve a community's governance, educational system, and infrastructure has been proven to be effective in raising people's living standards (Sachs 238) and could be used to assist rural Dominicans. Sachs' tells the story of women in India who must pay the majority of their earnings to rent the cart needed to sell food, keeping them from building any savings to purchase a cart. Loans with little to no interest can allow these women to take the first step out of poverty, and will impact their entire families. New forms of financing could be used to introduce new technology in schools, businesses, and industries. The cane industry, in particular, could benefit greatly from mechanization; this would reduce the number of available jobs for the lower levels of society, but it would allow people at those levels to have safer working conditions and learn new skills, which would become more and more valuable as the Dominicans attained higher levels of education and technology.

Education is the key to enabling Dominicans to reach their potential in terms of racial understanding and acceptance of Haiti and people from Haiti. Teaching farmers new ways to fertilize, protect plants, and keep the soil fertile for the following year's crops would assist Dominicans in dispelling economic concerns tied to race by bringing themselves and Haitians to a higher standard of living. Cooperative efforts between the farmers of each nation or foreign investment could aid in this effort. More jobs would be created, the two countries would be more stable, and fewer people would starve if such a program were implemented.

Higher education should be rewarded by better, more specialized jobs and higher pay. This will help students understand the value of learning and should encourage them to make school a priority. Higher teacher salaries and a more favorable teacher-student ratio could make teaching

more appealing to qualified candidates. Lectures could be given at universities to educate tomorrow's leaders on issues causing the Dominican Republic to remain behind other nations in terms of economics, education, and racial views. Educational events could take the form of literature workshops, concerts given by students of various ethnicities, art exhibits, or television documentaries. None of the educational improvements suggested are guaranteed to reduce or eliminate racism and prejudice in the Dominican Republic. However, racial issues are embedded in all parts of Dominican life. If people learn to think of all men as equal, their actions will reflect it.

Destroying myths about the ancestry of most Dominicans and unfounded generalizations about Haitians and Haitian-Dominicans would greatly assist the Dominican people in developing community and national unity. All children attending school could receive explicit education about the value of every human being, scientific proof regarding the non-existence of "races," and how the history of Haiti and the Dominican Republic has affected/influenced the Dominican perception of race. School activities could be planned to celebrate Haitian heritage or the common history of the Dominican Republic and Haiti.

Raising education levels and creating/enforcing standards would help students prepare to be future business leaders or to work in higher paying positions as new companies would move to or would be created in the Dominican Republic. In cities or villages, classes could be conducted to educate people on how to save, borrow, invest, and spend money wisely as the economy begins to grow. As with education, these steps to economic equality among all people of the Dominican Republic, regardless of race, do not guarantee the elimination or even decline of racism. Less economic disparity would only provide Dominicans with a solid economic foundation, allowing them to be less threatened by Haitian workers.

In order to ease the Dominican discrimination of Haitians, it is necessary to complete a number of tasks in the political realm. The Dominican government censored articles in newspapers and books for many years. For example, Ramón Marrero Arísty, author of the novel *Over* (1939) about the plight of sugar-cane cutters, was murdered under the direction of the Trujillo regime. Government censorship of the press needs to be permanently eliminated, and libraries and books need to be more accessible to everyone. *Cédulas*, or identification cards, should be given to all who are determined to be citizens according to Dominican law, regardless of their class, race, etc. Citizenship should be more clearly established in the constitutions of Haiti and the Dominican Republic. The Dominican Republic, for example, should thoroughly detail what it means to be "in transit" so that people who have lived in the Dominican Republic for twenty years cannot be termed "in transit". It is also imperative that Haiti and the

Dominican Republic agree on what it means to be a citizen in each country. Since the Dominican Republic denies dual citizenship, it is difficult for Haitians to become permanent, legal employees in the Dominican Republic. Government documents that ask for racial information should not link race to nationality. For example, instead of "negro haitiano" (black Haitian) on an identification card, it would be logical to simply write "negro".

Trade and working agreements between the Dominican Republic and Haiti could be successful (if properly enforced) in helping to eliminate Dominican distrust for Haitians. Although the Haitian and Dominican governments have tried to establish a permanent border for many years, the terrain and lack of officials to enforce policy still allow residents from Haiti to live on Dominican soil and vice versa without even knowing it. Border laws to which both Haiti and the Dominican Republic agree should be established and enforced. Haitians already established in the Dominican Republic should be protected by these laws. Haiti and the Dominican Republic could agree to the maximum number of hours immigrants and even natives are allowed to work. They could also agree to fair wages, overtime pay, and decent working condition standards. The Dominican Republic and Haiti would also need to coordinate efforts to enforce such agreements.

Catholic and Protestant churches can take an active role in promoting unity, particularly among believers, between people of different races. They can also promote respect for all people and respect for oneself regardless of race. Since the Holy Bible firmly supports unity in the church (Ephesians 4) and states that all people are equal in God's eyes, regardless of their social standing or ethnicity (Galatians 3), these ideas can be emphasized from the pulpit, in religious schools, and in church classes to proactively influence people to think in new ways. All Haitian street children should receive care from adoptive parents or orphanages (some already do receive care), so they do not turn to criminal behavior when they are older. To implement a small-scale version of that process, privately-funded campaigns could be introduced to inspire Dominicans to be mentors in local churches, schools, or community centers. Ninety-eight percent of the Dominican people profess Roman Catholicism and usually have access to either a church or a Christian television program of some sort (if they have television). Thus, revaluing race through churches could be extremely effective.

The large Dominican-American population should eventually relieve some of the Dominican denial of race and ancestry. In the ethnically diverse and more egalitarian society of the United States, where black people can be top executives and government officials alongside white people it would be difficult for Dominicans living in the United States, or with relatives in the United States, to continue to divide people into classes, status, and acceptance by color and features alone.

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Haitians are a part of the Dominican community as much as Africa is in Dominican blood. The only viable solution to solving any problem related to Dominicans not accepting Haitians or to denying their own ancestry is to first lead them to acknowledge that there are inherent problems in not accepting all people as equal and in not accepting oneself. Education, government reform, economic reform, and literary movements can assist in bringing people to this conclusion and continuing to develop a more refined view of race as time passes.

¹ "El Negro Tras de La Oreja" was a poem written by Creole Juan Antonio Alix in 1883.

² Literally, *el campo* translates as the countryside, but when said, it implies a somewhat desolate place outside the city that is impoverished.

³ "La Mulata" refers to a woman of both African and European heredity.

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Mentor Comments

Dr. Steven M. Bell provides an overview of the significance of Ms. Harris' research, describing how it evolved from the passion that stems from first hand experiences to a reasoned exploration of the topic of race in the Dominican Republic.

Megan Harris's thesis, from which the submitted essay has been distilled, shows an advanced understanding of the subtle and not-so-subtle dynamics of race relations in the Dominican Republic and on the island of Hispaniola, which the Dominican Republic shares with Haiti. Megan touches in due course upon the political and the economic, as well as the social, cultural, and historical implications of this important national and transnational issue. The level of understanding her thesis shows is not easily achieved, particularly by a student at the undergraduate level, and Megan has articulated these various dimensions of the phenomenon clearly, with very little of the kind of oversimplification normally inherent in such a broad and complex undertaking.

Miscegenation, rather than segregation, has historically been the predominant force shaping race in Spanish America. This fact has led some casual observers to conclude that racism, as such, does not exist in Spanish America. Megan's thesis chimes in categorically to reaffirm that nothing could be farther from the truth; that racism is indeed a universal phenomenon that nonetheless exhibits great variety in its concrete actualizations. Indeed, she shows how the Dominican Republic offers up a particularly acute example of the centrality of race in Latin America where, perhaps more than anywhere, the conclusion that race, rather than a biological fact, remains first and foremost an interested social and historical construct through and through, can quite clearly be drawn.

Megan's thesis was born, as many are, directly from her study abroad experience as a University of Arkansas exchange student in the Dominican Republic in the Spring 2005 semester. She brings to her subject, as a result, a passion and compassion derived from direct personal experience that greatly enrich and authorize her project. Her work confirms what many of us know all too well: that of the many kinds of academic opportunities we are able to offer our students, study abroad is one virtually certain to constitute one of those rare and truly invaluable, "life-changing" experiences.

Since that seminal moment when she first tentatively outlined her topic, Megan's views on the functioning of race in the Dominican Republic, and the shape and nature of her thesis, have evolved from a rather simple and visceral rejection of the patent contradictions coloring the surface of race relations on the island

of Hispaniola, to a much more human and humane, nuanced and comprehensive, understanding of the social and economic, political and historical conditions that shape the discourse on race today in the Dominican Republic. The "action list" that she proposes for the "reevaluation" of race in the

Dominican Republic in her conclusions is not only well reasoned and reasonable: it contains essential principles by which people everywhere in our planetary society would do well to abide.

I recommend her essay to you highly.